3.3 Water Resources - Water Quality

3.3.1 Regulatory Framework

The NDEP requires compliance with National Pollution Discharge Elimination System (NPDES) permits related to discharge to waters of the U.S. of wastewater to surface waters from discharge points such as tailings piles and wastewater ponds, as well as with NPDES permits related to discharge to waters of the U.S. of storm water runoff. NDEP also requires that discharges into subsurface waters be controlled if the potential for contamination of ground water supplies exist. In such instances a State of Nevada zero-discharge permit is required.

The Nevada Water Pollution Control Law provides the state the authority to maintain water quality for public use, wildlife, existing industries, agriculture, and the economic development of the site. The NDEP defines waters of the state to include surface water courses, waterways, drainage systems, and underground water. The Nevada Water Pollution Control Law also gives the State Environmental Commission authority to require controls on diffuse sources of pollutants, if these sources have the potential to degrade the quality of the waters of the state. The EPA has also granted Nevada authority to enforce **DWS** established under the Safe Drinking Water Act.

The State of Nevada classifies surface water bodies into four classes; Class A, Class B, Class C, and Class D. Each class has associated water quality standards. Class A waters include waters or portions of waters located in areas of little human habitation, no industrial development or intensive agriculture and where the watershed is relatively undisturbed by man's activity. The beneficial uses of Class A waters are municipal or domestic supply, or both, with treatment by disinfection only, aquatic life, propagation of wildlife, irrigation, watering of livestock, recreation including contact with the water and recreation not involving contact with the water. Class B waters include waters or portions of waters that are located in areas of light or moderate human habitation, little industrial development, light-to-moderate agricultural development, and where the watershed is only moderately influenced by man's activity. The beneficial uses of Class B water are municipal or domestic supply, or both, with treatment by disinfection and filtration only, irrigation, watering of livestock, aquatic life and propagation of wildlife, recreation involving contact with the water, recreation not involving contact with the water, and industrial supply. Class C waters include waters or portions of waters that are located in areas of moderate-to-urban human habitation, where industrial development is present in moderate amounts, agricultural practices are intensive, and where the watershed is considerably altered by man's activity. The beneficial uses of Class C water are municipal or domestic supply, or both, following complete treatment, irrigation, watering of livestock, aquatic life, propagation of wildlife, recreation involving contact with the water, recreation not involving contact with the water, and industrial supply. Class D waters include waters or portions of waters located in areas of urban development, highly industrialized or intensively used for agriculture or a combination of all the above and where effluent sources include a multiplicity of waste discharges from the highly altered watershed. The beneficial uses of Class D waters are recreation not involving contact with the water, aquatic life, propagation of wildlife, irrigation, watering of livestock, and industrial supply, except for food processing purposes.

Roberts Creek and its tributaries are Class A water bodies from the headwaters to the reservoir and Class B water bodies below the reservoir. Denay Creek and its tributaries from the headwaters to Tonkin Reservoir and the Reservoir itself are Class A water bodies. Denay Creek below Tonkin Reservoir is a Class B water body. J.D. ponds are Class C water bodies. These water bodies have aquatic life, livestock, recreation, irrigation, and other beneficial uses. All other perennial streams in the vicinity of the Project Area are unclassified.

The applicable surface water and ground water quality standards for inorganic compounds in Nevada are summarized in Table 3.3-1. These standards are based both on aquatic toxicity criteria and the proposed use of the water.

3.3.2 Affected Environment

3.3.2.1 Study Methods

Water Resources - Water Quality information, descriptions, and data are based on technical reports addressing geochemistry and pit water quality that were prepared for EML. The reports include the Mount Hope Project Waste Rock and Pit Wall Rock Characterization Report (SRK 2008d) and the Mount Hope Project Final Pit Lake Geochemistry Report (SWS 2010).

3.3.2.2 Existing Conditions

3.3.2.2.1 Surface Water Quality

Surface water from springs and perennial streams in the Mount Hope area is generally of good quality, i.e., meeting all Nevada water quality standards at most locations (SRK 2008d). The locations where water quality standards are not met tend to fall into one of four general categories:

1. Waters that have elevated TDS, SO_4, or pH. In xeric environments, some locations have water that has undergone extensive evaporation. This evaporation leads to elevated levels of TDS and SO_4, as well as elevated pH;
2. Spring waters with elevated Mn or Fe. Mn and Fe are naturally mobile under the reducing conditions of most ground water; therefore, their concentrations would be higher, often exceeding regulatory standards. However, when these waters emanate into the oxidizing conditions found in surface waters, the Fe and Mn in these waters would rapidly precipitate;
3. Anomalous elevated metals in a single sample. At three locations, metals are found above regulatory limits for a single sample. All other samples at these locations are below regulatory limits and usually below detection; and
4. The Zinc Adit. At the Mount Hope mine site there is water emanating from the Zinc Adit. Prior to discharge from the adit, this water migrates through the zones of mineralization in the Mount Hope ore deposit where propylitically altered rock, enriched with sulfide minerals and trace elements, provides the water with its unique chemical signature. This mineralized material would be removed through the development of the open pit under the Proposed Action. In addition, the source of the water discharging from the adit and the adit itself would be removed.

3.3.2.2.2 Ground Water Quality

The applicable ground water quality standards for inorganic compounds in Nevada is summarized in Table 3.3-1 under the Maximum Contaminate Levels (MCLs) column. These standards are based both on aquatic toxicity criteria and the proposed use of the water, and with the exception of the aquatic life standards are the same for surface water.

Similar to the surface water in the vicinity of Mount Hope, ground water is generally of good quality. Similar to the spring data, there are some elevated levels of Mn, and elevated pH over the standard of 8.5.

Near the ore deposit, reducing conditions created by the presence of sulfides in the ore result in water from wells commonly exceeding regulatory standards for Fe and Mn, with several wells also having elevated TDS and SO_4. Well IGM-169 has elevated levels of fluoride, Al, and As present in its water, likely related to the abundant sulfide mineralization observed in the drill cuttings from the well. These reported data are from an open borehole as opposed to the standard method of obtaining data from a completed monitoring well. The pH of IGM-169 is unusual in that it has values below the NDEP standard of 6.5 to 8.5; however, the pH values generally ranged from 6.8 to 7.2 in the remainder of the sample sites. This well is located in the upper propylitic alteration zone of the ore deposit, where this type of chemistry signature in the water would be expected.

Table 3.3-1: Standards for Toxic Materials Applicable to Designated Waters

Chemical	Maximum Contaminate Levels (mg/L)	Aquatic Water Quality Micrograms per liter (µg/L)	Irrigation (µg/L)	Watering Livestock (µg/L)
Aluminum	0.2	-	-	-
Antimony	0.006	-	-	-
Arsenic	0.010	-	100[b]	200[c]
Arsenic (III)	-	-	-	-
1-hour average	-	342[a,e]	-	-
96-hour average	-	180[a,e]	-	-
Barium	2	-	-	-
Beryllium	0.004	-	100[b]	-
hardness≤75mg/L	-	-	-	-
hardness≥=75mg/L	-	-	-	-
Boron	-	-	750[a]	5,000[c]
Cadmium	0.005	-	10[d]	50[c]
1-hour average	-	0.85 exp {1.128In(H)-3.828][a,e]	-	-
96-hour average	-	0.85 exp {0.7852In(h)-3.490}[a,e]	-	-
Chromium (total)	0.1	-	100[c]	1,000[c]
Chromium (VI)	-	-	-	-
1-hour average	-	15[a,e]	-	-
96-hour average	-	10[a,e]	-	-
Chromium (III)	-	-	-	-
1-hour average	-	0.85 exp {0.8190In(H)+3.688}[a,e]		-
96-hour average	-	0.85 exp {0.8190In(H)+1.561}[a,e]		-
Copper	1.0	-	200[c]	500[c]
1-hour average	-	0.85 exp{0.9422In(H)-1.464}[a,e]	-	-

Chemical	Maximum Contaminate Levels (mg/L)	Aquatic Water Quality Micrograms per liter (µg/L)	Irrigation (µg/L)	Watering Livestock (µg/L)
96-hour average	-	0.85 exp {0.8545In(H)-1.465}[a,e]	-	-
1-hour average	-	22[a]	-	-
Cyanide	0.2	-	-	-
96-hour average	-	5.2[a]	-	-
Fluoride	0.14	-	1,000[c]	2,000[c]
Iron	0.3	1,000[a]	5,000[c]	-
Lead	0.015	-	5,000[c]	100[c]
1-hour average	-	0.50 exp {1.273In(H)-1.460}[a,e]	-	-
96-hour average	-	0.25 exp {1.273In(H)-4.705}[a,e]	-	-
Manganese	0.05	-	200[c]	-
Mercury	0.002	-	-	10[c]
1-hour average	-	2.0[a,e]	-	-
96-hour average	-	0.012[a]	-	-
Molybdenum	-	19[d]	-	-
Nickel	-	-	200[c]	-
1-hour average	-	0.85 exp {0.8460In(H)+3.3612}[a,e]		-
96-hour average	-	0.85 exp {0.8460In(H)+1.1645}[a,e]		-
Selenium	0.05	-	20[c]	50[c]
1-hour average	-	20[a]	-	-
96-hour average	-	5.0[a]	-	-
Silver	0.1	0.85 exp {1.72In(H)-6.52}[a,e]	-	-
Sulfate	250	-	-	-
Sulfide (Undissociated hydrogen sulfide)	-	2[a]	-	-
Thallium **(Tl)**	0.002	-	-	-
Zinc	5	-	2,000[c]	25,000[c]
1-hour average	-	0.85 exp {0.8473In(H)+0.8604}[a,e]		-
96-hour average	-	0.85 exp {0.8473In(H)+0.7614}[a,e]		-

1 Single concentration limits and 24-hour average concentration limits must not be exceeded. One-hour average and 96-hour average concentration limits may be exceeded only once every three years. See reference a.
2 Hardness is expressed as mg/L calcium carbonate.
3 If a criterion is less than the detection limit of a method that is acceptable to the division, laboratory results which show that the substance was not detected would be deemed to show compliance with the standard unless other information indicates that the substance may be present.
4 If a standard does not exist for each designated beneficial use, a person who plans to discharge waste must demonstrate that no adverse effect would occur to a designated beneficial use. If the discharge of a substance would lower the quality of the water, a person who plans to discharge waste must meet the requirements of NRS 445A.565.
5 The standards for metals are expressed as total recoverable, unless otherwise noted.
a EPA, Pub. No. EPA 440/5-86-001, Quality Criteria for Water (Gold Book) (1986).
b EPA, Pub. No. EPA 440/9-76-023, Quality Criteria for Water (Red Book) (1976).
c National Academy of Sciences, Water Quality Criteria **1972** (Blue Book) **(1973)**.
d California State Water Resources Control Board, Regulation of Agricultural Drainage to the San Joaquin River: Appendix D, Water Quality Criteria (March 1988 revision).
e This standard applies to the dissolved fraction. (Added to NAC by Environmental Commission, eff. 9-13-85; A 9-25-90; 7-5-94; A 11-29-95).

Source: NAC 445A.144, which states, "except as otherwise provided in this section, the following standards for toxic materials are applicable to the waters specified in NAC 445A.123 to 445A.127, inclusive, and NAC 445A.145 to 445A.225, inclusive". If the standards are exceeded at a site and are not economically controllable, the commission would review and adjust the standards for the site.

Overall, the ground water from within the ore deposit and from the surrounding area has relatively high levels of alkalinity (generally over 100 mg/L calcium carbonate [$CaCO_3$]) and somewhat elevated levels of SO_4 (generally over 100 mg/L as SO_4, ranging up to 1,000 mg/L as SO_4). These waters generally fall into the classification as calcium bicarbonate to calcium sulfate waters. **The samples of ground water from the Project Area consistently exceeded the Nevada reference values for Mn, with values that range from 0.0076 to 25 mg/L. Less frequent exceedances, but still numerous, were Fe, Al, pH, SO4, TDS, and F (SRK 2008a).**

3.3.2.2.3 Waste Rock Characterization

Characterization Assessment Plan

Ore and waste rock from the Mount Hope deposit has been extensively characterized by SRK (2008d). The Waste Rock Report presents a detailed scheme for characterizing waste rock that incorporates whole rock analysis, ABA, MWMP testing, NAG testing, mineralogical characterization, and HCTs (Figure 3.3.1).

As a porphyry sulfide ore body, the deposit has very low levels of sulfide while having almost no carbonate to neutralize any acid that the low levels of sulfide may generate. Therefore, the characterization of waste rock focuses on determining the threshold at which sulfide overcomes the acid generating capacity of the rock and causes water quality issues.

Whole Rock Analyses

Whole rock analyses were conducted on 250 samples from the Mount Hope deposit using induced coupled plasma-mass spectrometry (ICP-MS). Due to the very nature of an orebody, there were observed enrichments in several elements, including silver (Ag), As, Cd, Mo, S, Sb, Se, Sn, and Zn throughout the orebody. In general, the enrichment was correlated more with the degree of enrichment than the lithology type. In the outer phyllic and argillic alteration halos, Th, Pb, and Cu are also present. The highest degree of elemental enrichment is observed in the skarn mineralization on the east side of the proposed open pit, which is associated with Zn sulfide replacement mineralization. The enriched Zn zone is where previous mining occurred during the 1940s. The skarn zone is also enriched in beryllium (Be), Fe, Pb, Sn, Mn, and S. Whole rock analyses did not analyze for fluorine (F) as an element, due to the limitations of the digestion method, (dissolving samples in hydrofluoric acid). However, mineralogical analysis indicated that elevated levels of fluorite are present in the skarn, potassic, and biotite alteration zones.

Mineralogic Analyses

Mineralogic analyses of the deposit have been conducted by SRK (2008d) and many other exploration programs. The key findings show that there is very little carbonate present (except in the outer propylitic alteration zone) in the deposit. Molybdenite and pyrite (PAG sulfides) are present in the main ore zone; however, in comparatively low concentrations.

Static Testing

Static testing included MWMP, ABA, and NAG testing.

Meteoric Water Mobility Procedure Test Results

MWMP testing was conducted on 137 samples. MWMP testing provides an indication of whether rocks would leach constituents. However with sulfide-bearing materials, the results of the MWMP testing provide only an initial indication of the potential release of metals. Subsequent sulfide oxidation in a ore deposit, for which the MWMP test is not designed, would release additional constituents. As there is little oxidation in the deposit, MWMP testing primarily guided the selection of additional samples. MWMP testing did indicate that some samples (primarily from the phyllic, argillic, and silicic alteration types) generated several metals (including Al, Cu, Cd, Fe, Mn, and Zn) at elevated levels and low pH (less than 6.5).

Acid Base Accounting Test Results

ABA testing was also conducted on 137 core samples and 1,546 pulp samples using the modified Sobek method (Lawrence and Wang 1997). In short, this method measures the amount of sulfide and SO_4 present in the rock using LECO analyses, and total inorganic **carbon (**C**)** by a titration method. The S and C values are then converted to acid equivalence to assess whether the rock has the potential to generate acid.

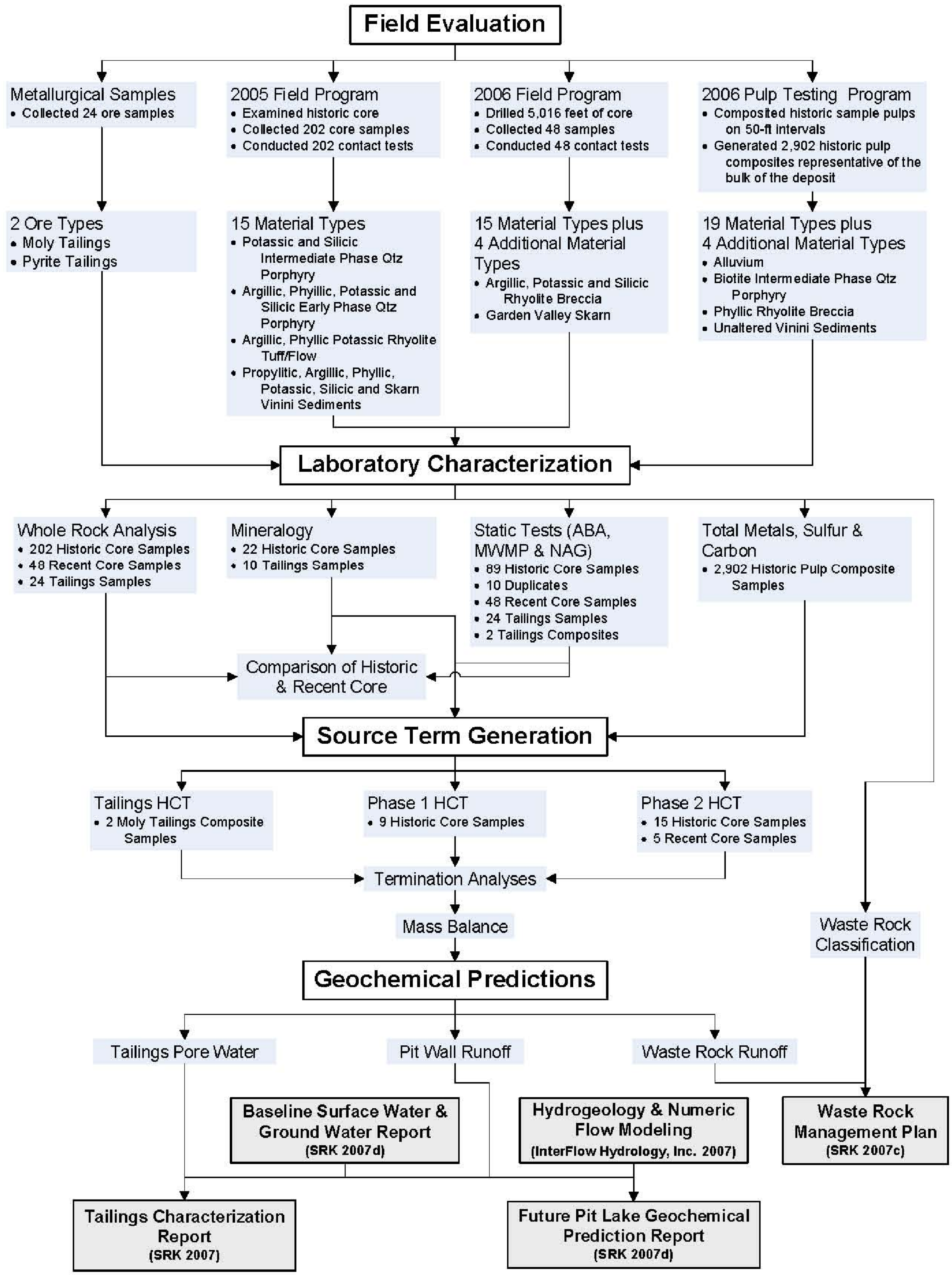
The method for calculating the acidification potential (AP) is based on the stoichiometry of the reaction of pyrite and the amount of sulfide S is multiplied by a coefficient to convert the value to an equivalent amount of acidity in terms of tons $CaCO_3$/1,000 tons (Ktons) rock to give the equivalent amount of acid the rock can generate. Similarly, based on the amount of inorganic C measured in the rock, the carbonate is converted to an equivalent neutralizing potential of $CaCO_3$ presented also in tons $CaCO_3$/Ktons rock to give the neutralization potential (NP).

The net neutralization potential (NNP) is the AP subtracted from the NP: NNP=NP-AP.

If the NNP is negative, there is more AGP than neutralizing potential, and the rock has the potential to generate acid. If the NNP is positive, the rock likely has an excess of neutralization capacity. There is an assumed stoichiometry of reactions that does not always strictly apply to all minerals because there is uncertainty associated with these measurements. Kinetic factors may affect the generation or consumption of acid. NNP results are characterized as three groups:

- If NNP is greater than 20 tons $CaCO_3$/Ktons, the rock is net neutralizing;
- If the NNP is between 20 and -20 tons $CaCO_3$/Ktons, the rock is assumed to have an uncertain or weak AGP; and
- If the NNP is less than -20, the rock is characterized as strongly acidic.

The AP and NP results from the deposit representative of the ore deposit geology and alteration types. Histograms of total S (Figure 3.3.2) and total C (Figure 3.3.3) indicate that both sulfide (with the majority of the samples below 0.3 percent sulfide) and carbonate (with the majority of the samples also below 0.3 percent) are very low in the ore and waste rock. Many samples have very low sulfide and carbonate values; therefore, a plot of NNP versus sulfide S (Figure 3.3.4) shows that most samples are very close to zero, with a tail of acid generating samples trailing off at sulfide S values greater than 0.5 percent. Therefore, the majority of the samples at Mount Hope have an NNP value between -20 and 20 tons $CaCO_3$/Ktons rock, which is within the uncertain range for the NP.



BATTLE MOUNTAIN DISTRICT OFFICE Mount Lewis Field Office 50 Bastian Road Battle Mountain, Nevada 89820		BUREAU OF LAND MANAGEMENT MOUNT HOPE PROJECT	DRAWING TITLE: **Characterization Program Flow Diagram** **Figure 3.3.1**
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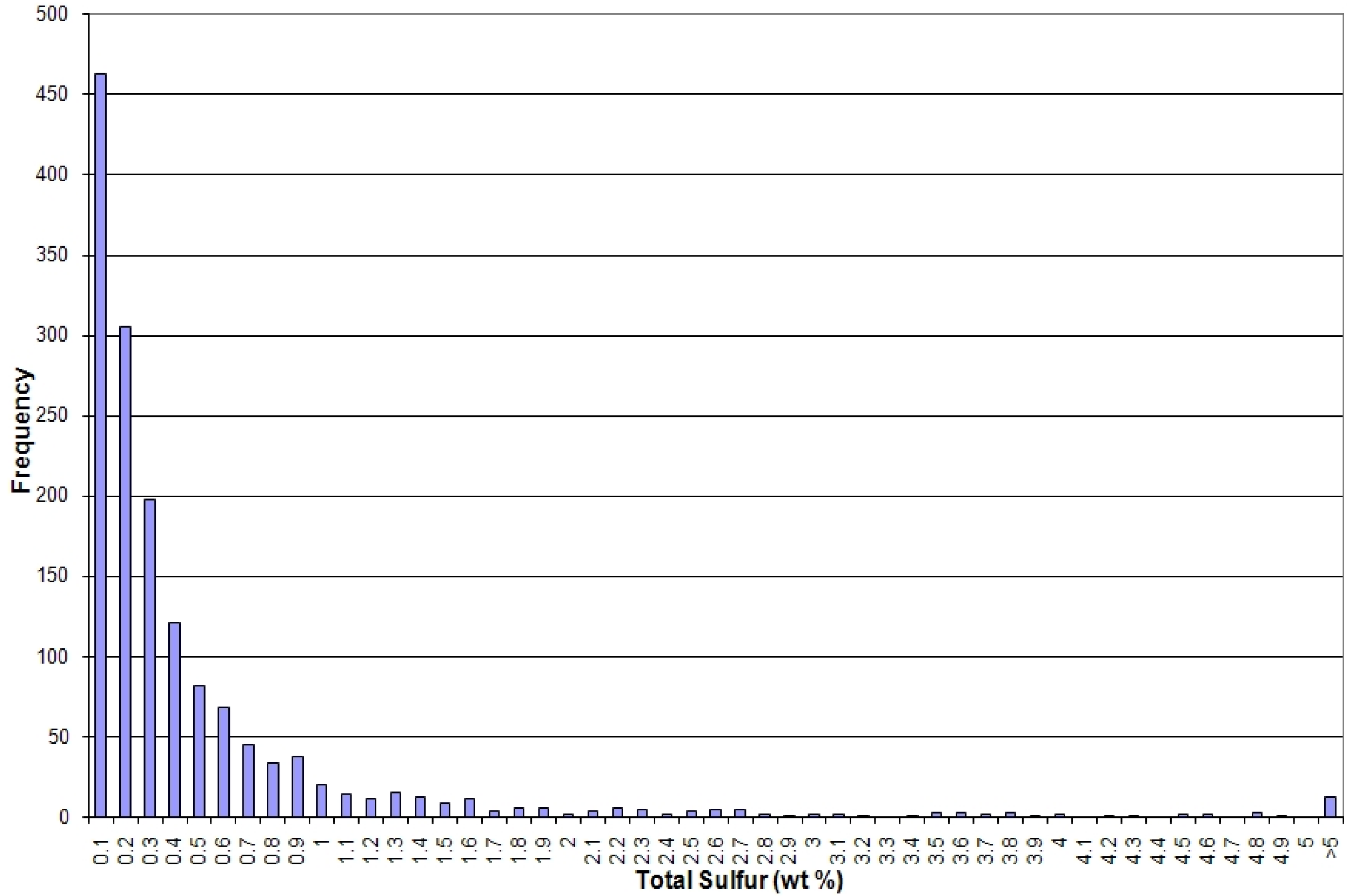

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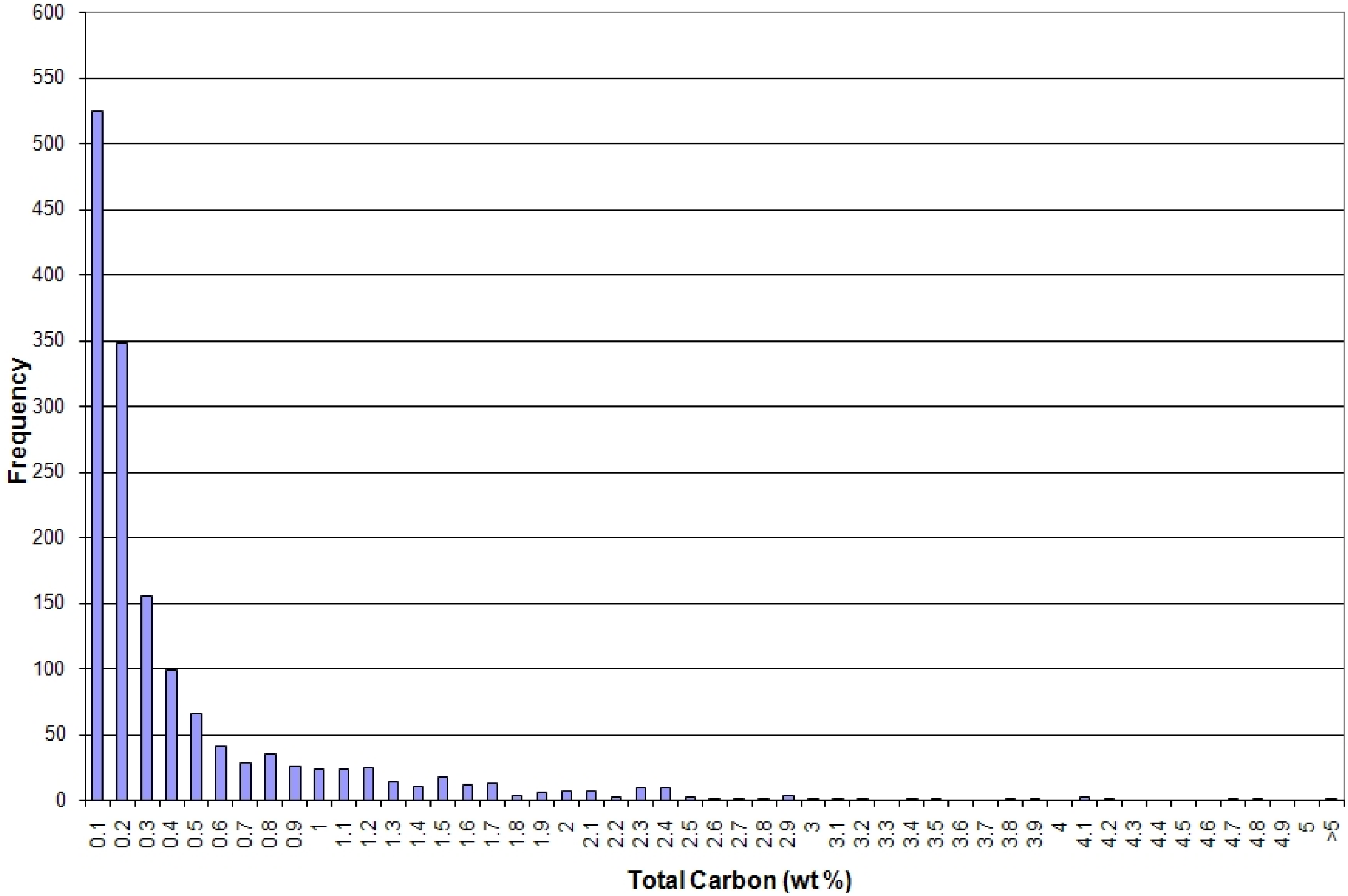
Total Sulfur Histogram for Mount Hope Waste Rock Samples

Figure 3.3.2



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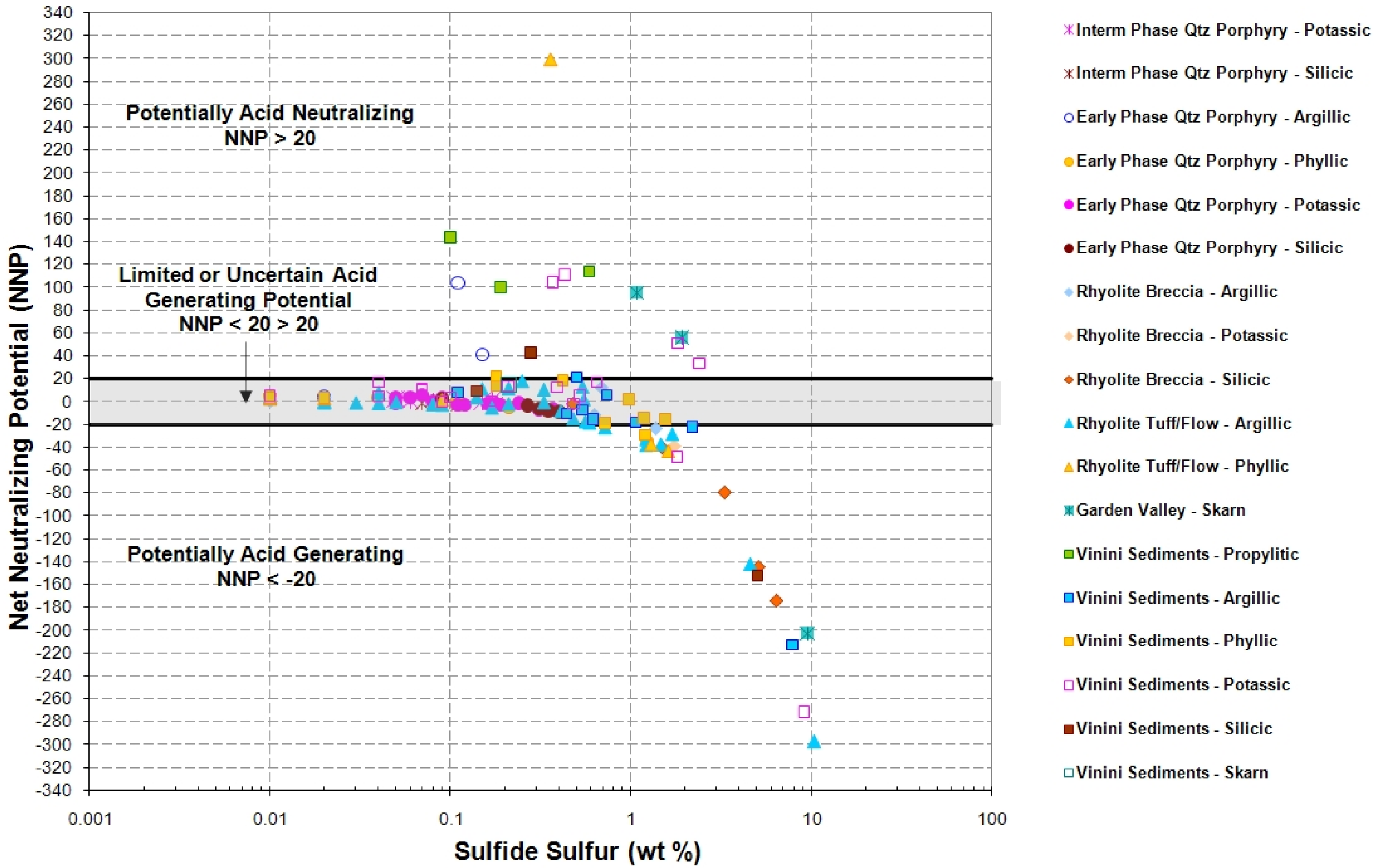
DRAWING TITLE:

Total Carbon Histogram for Mount Hope Waste Rock Samples

Figure 3.3.3



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Net Neutralization Potential Versus Sulfide

Figure 3.3.4

Net Acid Generation Testing

NAG testing is a peroxide digestion of samples using the method of Miller et al. (1997). The peroxide in this digestion would oxidize the sulfide minerals in the samples, generating acid. If inadequate neutralization is present in the rock material, the final NAG effluent would be acidic. It is a test that determines how much acid a sample would generate, the test does not assess the neutralization potential of a material. NAG test results fall into three separate categories, based on both the pH and the total acidity of the NAG effluent:

- Highly acid generating samples with a pH of less than 4 and acidity greater than ten kilograms (kg) H_2SO_4 per ton of rock;
- Lower capacity acid generating samples with a pH less than 4 and an acidity less than ten kg H_2SO_4 per ton of rock; and
- Non acid forming materials with a pH greater than 4.

NAG testing is a quick, reliable means to gain insight into the true acid generating capacity of a sample. In many ways, NAG testing is a reasonable worst-case scenario for acid generation for a sample, as the test achieves nearly complete oxidation of the sulfide minerals, a situation that rarely occurs in field settings.

The results of the NAG testing are shown in Figure 3.3.5. This figure shows the final NAG acid generation plotted against the NAG pH. The results of this testing show a bimodal distribution of results with a hockey-stick shaped plot. Tests having a pH greater than 4 and having low levels of acid generation plot on a flat line above pH 4; samples with a final NAG pH greater than 4 have a linear uptick in acidity as the pH decreases. Figure 3.3.6 shows the NAG acidity plotted against total S in samples. The total S content of 0.3 percent appears to be a clear demarcation line. Samples with less than 0.5 percent S generate no NAG acidity.

Summary of Static Testing

The static testing protocols provide two independent indicators of acid generation, ABA testing and NAG testing. These results show that materials with greater than approximately 0.3 percent sulfide S are likely to generate acid material. Samples with less than 0.3 percent total S never generated substantial acid (greater than two kg H_2SO_4 per ton of material).

Kinetic Testing

As a standard practice in Nevada, the HCTs were conducted to characterize the long-term acid generation of deposit materials (SRK 2008d; SWS 2010). Twenty-nine humidity cells were run for at least 70 weeks to characterize the generation of acid over time. The HCTs were run in accordance with ASTM Method D-5744-96. The HCTs are repeatedly put through seven-day cycles. In the first two days deionized water is trickled over the samples. This is followed by two days of exposure to moist air and then followed by two days of dry air. On the seventh day, the samples are rinsed with distilled water, and a sample is collected for analysis. Samples are analyzed on a weekly basis for pH, SO_4, acidity, alkalinity, conductivity, Fe, and reduction potential (Eh) over the full 70 weeks.

The HCTs serve multiple purposes. At their most basic level, HCTs provide the most definitive indication of whether or not a specific sample would eventually generate acid. The secondary application of HCTs is to generate source terms for additional geochemical modeling to quantify how waste rock and pit wall materials would interact with the environment. It is common for the chemistry of an HCT to evolve over time. One common pattern seen in HCTs is a delayed onset of acid generation for several weeks and then the sample suddenly turns acidic. Conversely, some humidity cells react quickly and all the sulfide is consumed or where acid generation happens so quickly that no additional acid is generated after a few weeks and the sample eventually evolves to a circumneutral pH.

As previously stated, the first goal of HCTs is to determine if rocks would ultimately generate acid. In practice, these more rigorous kinetic tests support the detailed static testing program that these samples have undergone. The humidity cells provide excellent validation of any rock characterization assessment plan. If the acid base classification assessment plan is correct and protective of the environment (conservative), HCTs should not generate acid when ABA and NAG testing indicated that acid would not be generated.

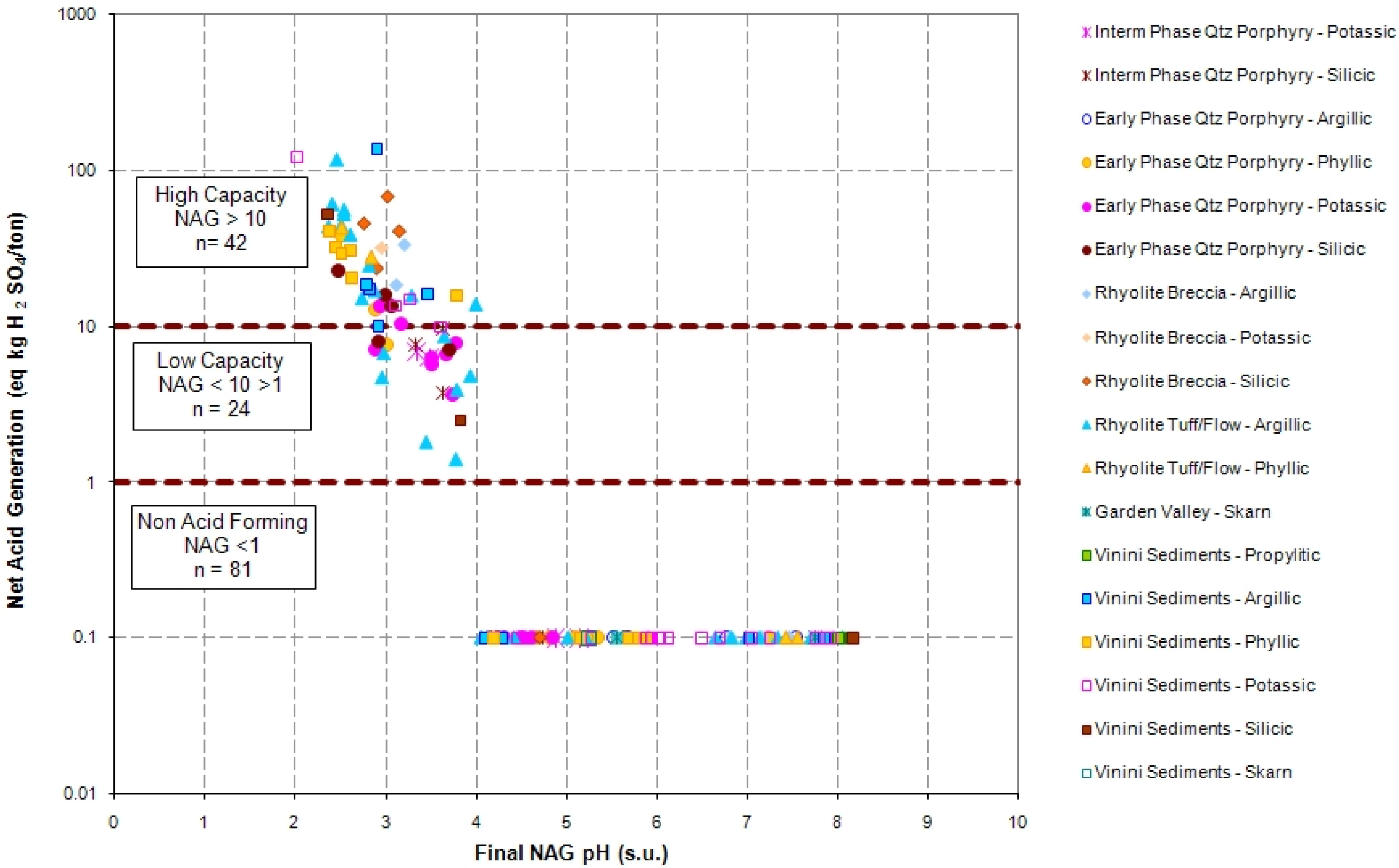
A comparison of the results of the HCTs to the static tests is presented in Table 3.3-2. Overall, 25 of the 29 cells have a behavior that comports with the predictions of the static testing. There are four samples (cells 9, 19, 26, and 30) for which either NAG or ABA static testing would predict that these samples would generate acid, but in fact, the HCTs did not. All samples that were predicted to be non-acid generating were found to be non-acid generating in the HCTs. These results are shown in Figures 3.3.7 and 3.3.8, which show that all samples that are below criteria identified in this study do not generate acid in HCTs. Overall, the HCTs are in excellent agreement with the static testing predictions. Where differences do arise between HCTs and static testing, the static testing tends to predict more acid generation than is found in HCTs.

Therefore, the static testing program appears to provide a conservative measure of whether or not a particular rock would generate acid.

HCT results also provide inputs into assessing the impacts to ground water and surface water quality from waste rock, tailings, and pit walls. The interpretation of the HCTs is discussed in detail in SRK 2008d and 2010. In short, the average concentrations of HCT effluents were used to provide baseline inputs to predict the water quality of waste rock drainage and pit lake water quality.

For some lithologic units, the HCT results show considerable variability within individual alteration and lithology types. For example, humidity cells 9, 18, and 31 are all from the Ordovician Vinni Formation with argillic alteration; however, all three cells have different pHs, and cells 18 and 31 are classified differently (18 as Non-PAG, 9 and 31 as PAG). Cells 18 and 31 both have similar levels of sulfide S (0.51 percent and 0.54 percent, respectively, and Cell 9 has a higher sulfide content of 2.41 percent). The observation of this amount of variability aids in the prediction of future environmental impacts at the mine, as it is important to understand this variability in assessing future effects.

Overall, the HCT effluents are generally stable and show no signs of becoming more acidic. Only one cell (Cell 6, a sample of potassic-altered Valmy Formation), showed any delayed onset of acid generation. The initial pH in the first week for Cell 6 was 3.2, but rose to pH 6.2 by week



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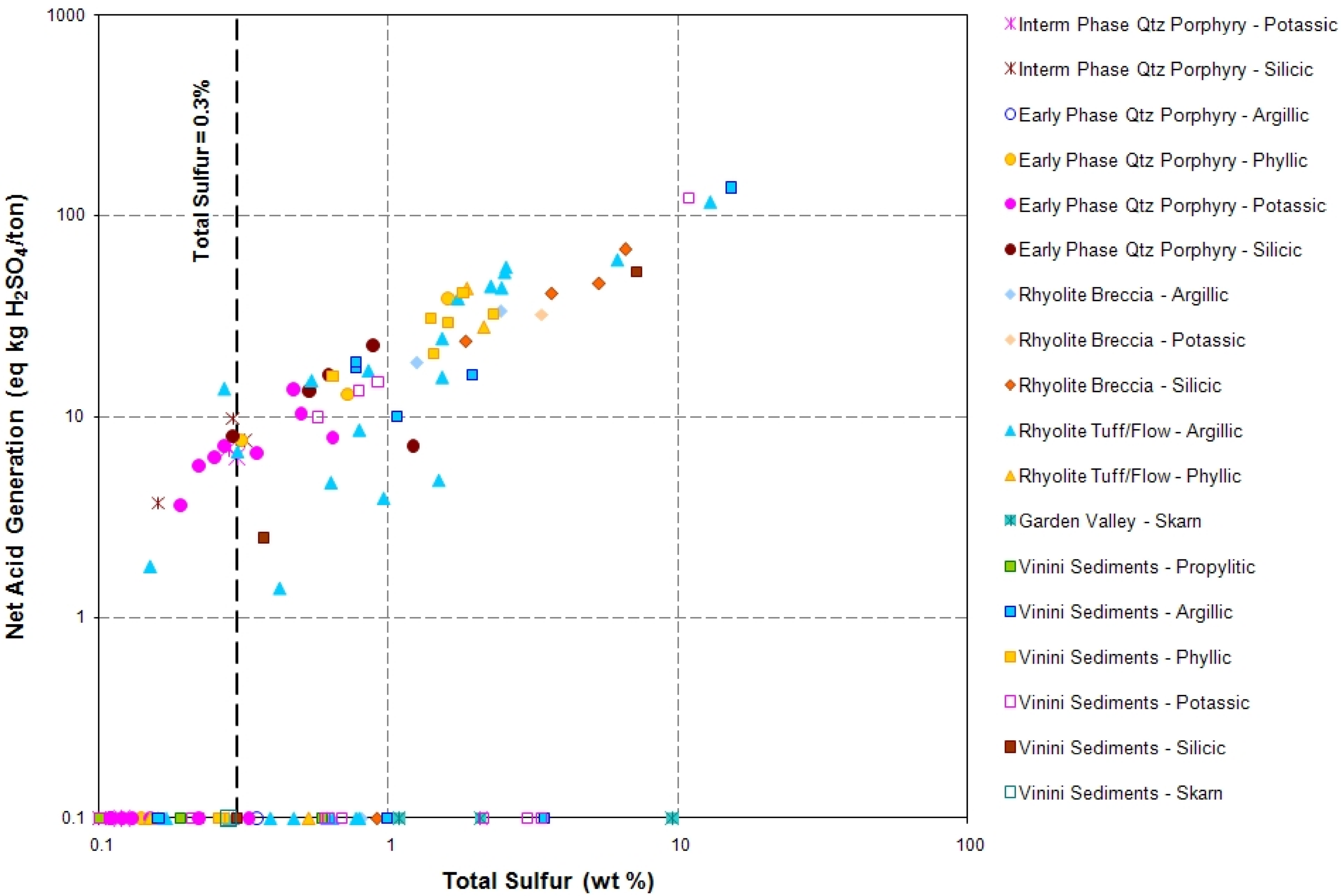
Net Acid Generation Versus Net Acid Generation pH

Figure 3.3.5



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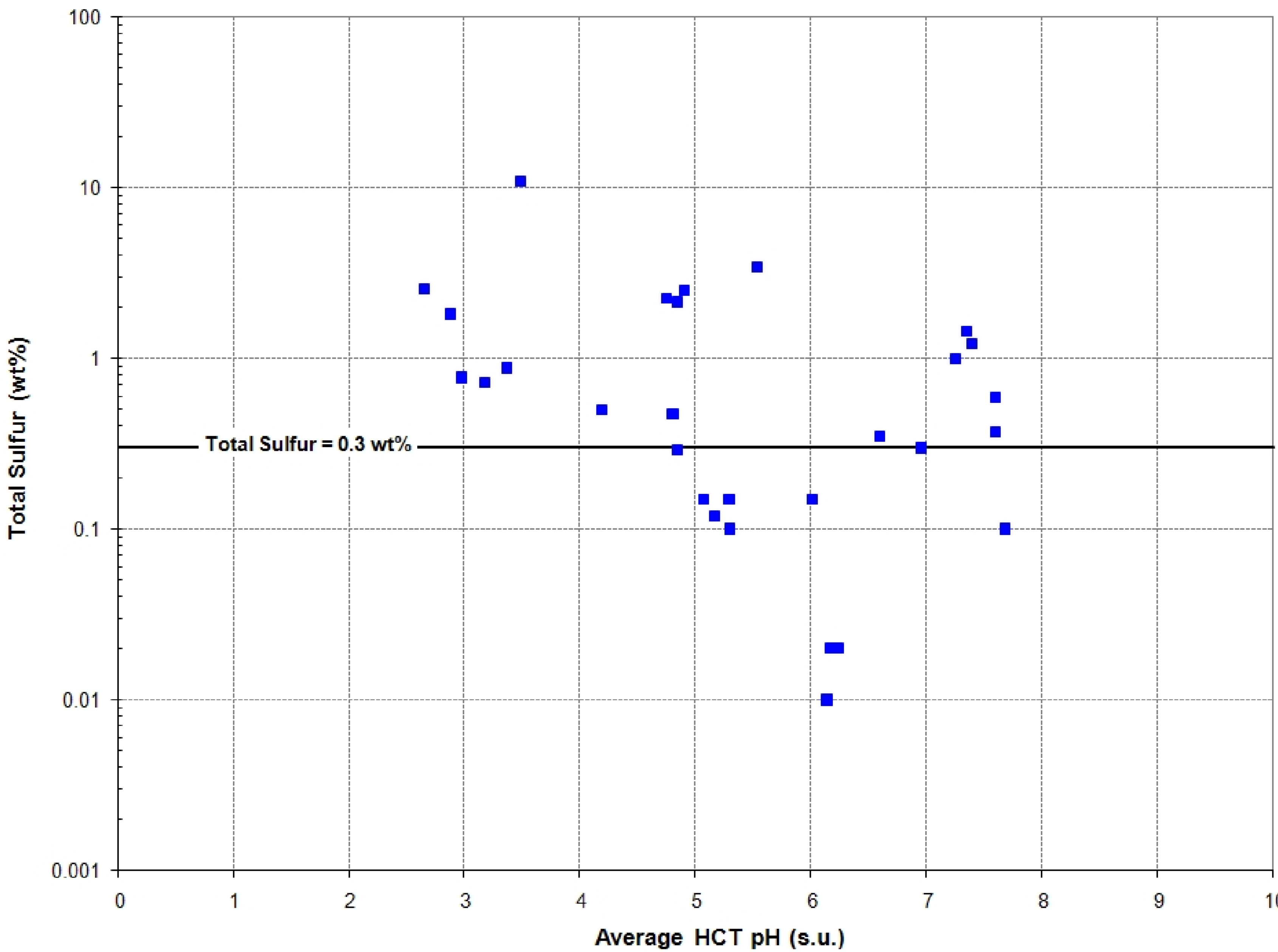
Total Sulfur Versus Net Acid Generation

Figure 3.3.6



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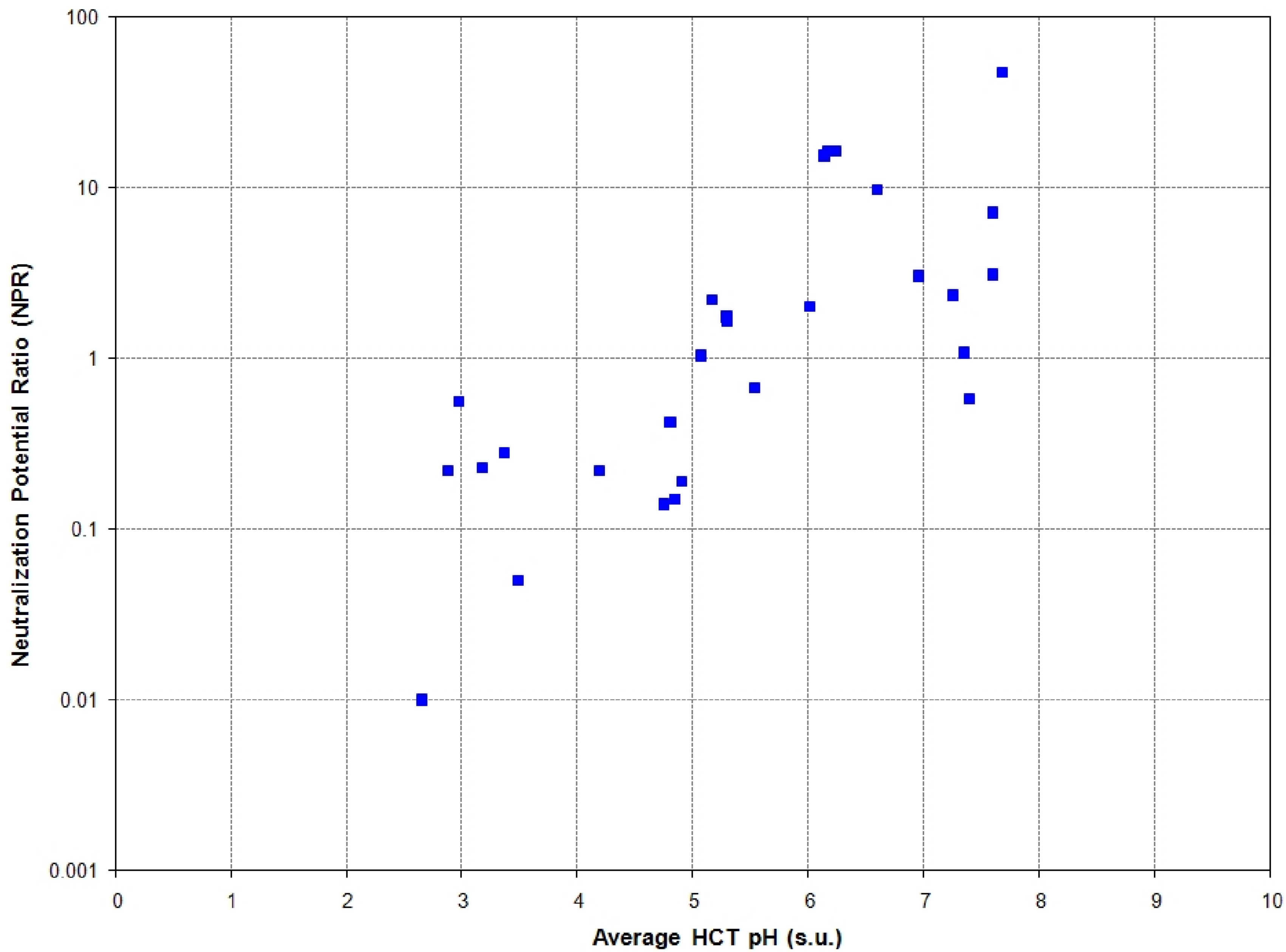
MOUNT HOPE PROJECT

DRAWING TITLE:

Total Sulfur Plotted Against the Average Humidity Cell pH

Figure 3.3.7



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MOUNT HOPE PROJECT

DRAWING TITLE:

Neutralization Potential Ratio Plotted Against Average Humidity Cell pH

Figure 3.3.8

nine, then slowly dropped to below pH 3 by week 30 of the testing, remaining below pH 3 to the end of the test. Metals and other constituent concentrations are generally stable or drop in all cells by the end of the tests, indicating that the tests have likely captured all potential geochemical behavior of these materials in the field.

Table 3.3-2: Comparison of Humidity Cell Test Results to Static Test Results

Cell #	Material Type[2]	Acid Generation Prediction From ABA[1]	NAG Test Prediction[1]	Acid Generation Prediction From HCT	MWMP Constituents Above NDEP Values	HCT Constituents Above NDEP Values
1	Tmr - Ar	uncertain	Non-PAG	Non-PAG	None	pH
2	Tqp - Ar	Non-PAG	Non-PAG	Non-PAG	None	None
3	Tmr - Ar	PAG	PAG	PAG	Al, Cd, Cu, fluoride, Fe, Pb, Mn, Ni, pH, SO_4, Tl, Zn	Al, As, Cd, fluoride, Mn, Ni, pH, SO_4, Tl, Zn
4	Tmr - Ar	PAG	PAG	PAG	Mn, pH, Zn	pH, Al, Mn, Zn
5	Ov - Pot	Non-PAG	Non-PAG	Non-PAG	None	None
6	Ov - Pot	PAG	PAG	PAG	Al, As, Cd, Cu, Fe, Pb, Mn, Ni, pH, SO_4, Tl, Zn	Al, As, Sb, Cd, Cu, Fe, Mn, Ni, pH, SO_4, Tl, Zn
7	Tqp - Pot	PAG	PAG	PAG	Mn	Al. As, Cd, Cu, Fe, pH
8	Tfr - Ar	Non-PAG	Non-PAG	Non-PAG	None	pH
9	Ov - Ar	PAG	Non-PAG	Non-PAG	Al, Cd, Cu, Fe, Pb, Mn, Ni, pH, SO_4, Tl, Zn	Al, As, Cd, F, Mn, Ni, pH, SO_4, Zn
12	Ov - Si	Non-PAG	uncertain	Non-PAG	None	As
13	Tqpa - Si	PAG	PAG	PAG	Al, Cd, fluoride, Mn	Al, Cd, fluoride, Mn, pH
14	Tqp - Ph	PAG	PAG	PAG	Al, Cd, Cu, Fe, Pb, Mn, Ni, Tl, Zn	Al, Cd, Cu, fluoride, Fe, Pb, Mn, Ni, pH, SO_4, Tl, TDS, Zn
15	Tqp - Si	PAG	PAG	PAG	None	Al, As, Cd, Cu, fluoride, Fe, Pb, Mn, pH, Zn
16	Tqp - Ph	Non-PAG	Non-PAG	Non-PAG	None	Cd, fluoride, Mn
17	Tqp - Ar	Non-PAG	Non-PAG	Non-PAG	fluoride, Mn	fluoride, Mn
18	Ov - Ar	Uncertain	Non-PAG	Non-PAG	Mn	Mn
19	Ov - Ph	PAG	PAG	Non-PAG	None	Mn
20	Ov - Pr	Non-PAG	Non-PAG	Non-PAG	None	As, Mn
21	Ov - Pr	Non-PAG	Non-PAG	Non-PAG	Mn	As, Mn
22	Tqpa - Si	uncertain	Non-PAG	Non-PAG	None	Al, Cd, fluoride, Mn, Zn
23	Tqpa - Pot	uncertain	Non-PAG	Non-PAG	None	Al, F, Fe, Mn, pH

Cell #	Material Type[2]	Acid Generation Prediction From ABA[1]	NAG Test Prediction[1]	Acid Generation Prediction From HCT	MWMP Constituents Above NDEP Values	HCT Constituents Above NDEP Values
24	Ov - Ph	PAG	PAG	PAG	Al, Be, Cd, Fe, Pb, Mn, Ni, SO_4	Al, Be, Cd, Cu, Fe, Pb, Mn, Ni, pH, SO_4, TDS, Zn
25	Tmr - Ph	uncertain	Non-PAG	Non-PAG	Al, fluoride, Mn	Al, fluoride, Mn, pH, Tl, Zn
26	Tqp - Si	PAG	uncertain	Non-PAG	None	Mn
27	Tmr - Ar	PAG	PAG	PAG	Al, Sb, Be, Cd, Cu, fluoride, Pb, Mn, Ni, Se, SO_4, Tl TDS, Zn	Al, As, Be, Cd, Cu, fluoride, Fe, Pb, Mn, Ni, pH, Se, SO_4, Tl TDS, Zn
28	Tmr - Ph	PAG	PAG	PAG	Cd, Mn, Ni, Th, Zn	Al, Cd, Pb, Mn, Ni, pH SO_4, Tl TDS, Zn
29	Tqp - Pot	PAG	PAG	PAG	fluoride, Mn	Al, Cd, fluoride, Pb, Mn, pH
30	Tqp - Pot	PAG	Non-PAG	Non-PAG	Al, fluoride, Mn	Al, fluoride, Mn, pH
31	Ov - Ar	PAG	PAG	PAG	Cd	Al, Be, Cd, Cu, fluoride, Fe, Pb, Mn, Ni, pH, Th

[1] Criteria used for this assessment are based on the discussion above.
[2] Tmr - Rhyolite Flow/Tuff; Ar - Argillic; Tqp - Early Phase Quartz Porphyry; Ov - Vinini Sediments; Pot - Potassic; Tqpa - Intermediate Phase Quartz Porphyry; Si - Silicic; Ph - Phyllic

3.3.2.2.4 Geochemical Characterization of Waste Rock

The prediction of waste rock geochemical behavior for the Project as described in SRK (2007a) is based on commonly applied criteria for static test results. For the MWMP tests, leachate chemistry data were compared to the comparative standards provided in NDEP WPCP Form 0090 for Profile II constituents to determine those that could exceed the comparative standards, and to what degree, when meteoric water contacted these rocks under certain conditions.

The waste rock characterization program was initially used to identify the potential of Project waste rock material to generate acid or to leach deleterious metals (Table 3.3-3). The results of this program were then applied to define a set of criteria for waste rock classification that can be used during implementation of the WRMP that routes waste rock materials to the different WRDFs.

3.3.3 Environmental Consequences and Mitigation Measures

3.3.3.1 Significance Criteria

Criteria for assessing the significance of potential impacts to the quality of water resources in the Project Area are described below. Impacts to water quality resources are considered to be significant if these criteria are predicted to occur as a result of the Proposed Action or the alternatives.

Table 3.3-3: Waste Characterization Summary

Rock Type	Primary Alteration	Percentage of Total Waste Based on Mine Model	Percentage of Waste Based on Mine Model		Percentage of Waste Based on the 1,546 Pulp Samples			MWMP Constituents Above NDEP Comparative Standards[c]
			Percent LPAG[1]/ Non-PAG	Percent PAG	Percent Non-PAG	Percent LPAG	Percent PAG	
Undefined	Undefined	0.6	73	27	NA	NA	NA	NA
Alluvium	NA	–[a]	–[a]	–[a]	100	0	0	--
Intermediate Phase Quartz Porphyry	Undefined	0.6	98	2	NA	NA	NA	NA
	Potassic	1.1	84	16	71	0	29	None
	Biotite	0.1	100	0	29	29	43	--
	Silicic	1.1	75	25	17	4	78	Cd, Mn
Early Phase Quartz Porphyry	Undefined	6.0	94	6	NA	NA	NA	NA
	Argillic	2.3	82	18	43	0	57	F, Mn
	Phyllic	0.1	10	90	74	1	25	Al, Cd, Cu, Fe, Mn, Pb, Th, pH (<6.5)
	Potassic	12.7	91	9	81	1	18	F, Mn
	Silicic	1.2	98	2	54	0	46	Mn
Rhyolite	Undefined	10.0	60	40	NA	NA	NA	NA
	Argillic	22.9	53	47	68	1	31	Al, Cd, Fe, Mn, Zn, pH (<6.5)
	Phyllic	0.6	30	70	51	2	47	Al, Cd, Mn, Zn
	Potassic	3.5	79	21	79	0	21	--
Vinini Formation Sediments	Undefined	20.5	80	20	NA	NA	NA	NA
	Propylitic	–[b]	–[b]	–[b]	–[b]	–[b]	–[b]	pH (<8.5)
	Argillic	2.9	56	44	70	0	30	Al, As, Cd, Cu, F, Fe, Mn, Ni, Pb, pH (<6.5)
	Phyllic	1.6	66	34	61	8	32	Al, F, Mn
	Potassic/Hornfels	12.1	89	11	71	7	22	Al, F, Mn
	Silicic[5]	0.1	100	0	60	0	40	Al, Cd, Cu, Fe, Mn, Nickel (Ni), Pb, Th, Zn, SO_4, TDS, pH (<6.5)
Totals		**100**	**74**	**26**	**67**	**3**	**30**	
			100		**100**			

NA = Not Applicable
– Indicates no data are available
[1]Limited Potentially Acid Generating (LPAG)
[a]Alluvium comprises an insignificant amount of the total waste rock and was not included in the calculation of waste rock volumes.
[b]Even though waste rock with propylitic alteration would be extracted from the open pit, the volume of this material type cannot be estimated because propylitic alteration was not recognized and documented in past exploration drill logs and as a result cannot be defined as a distinct alteration type in the current mine model.
[c]Determined from a statistical analysis of the data as described in SRK (2007a)

3.3.3.1.1 Surface Water Quality

- Release of mining-related contaminants such as cyanide, or metals such as As and Pb, into drainages by spills or flooding that results in soil or sediment contamination in excess of the NDEP standards specified at NAC 445A.2272.1.(c) or release of fuels and lubricants into drainages resulting in soil contamination exceeding the NDEP guidance level (100 milligrams [mg] per kg [mg/kg] of total petroleum hydrocarbons [TPH]).

- A discharge or change in water quality that results in an exceedance of the applicable water quality standards presented in Table 3.3-1 or specified in NAC 445A.453, or NDEP standards for aquatic life, irrigation, or livestock or potential beneficial uses in perennial streams, springs, seeps, and the post-mining pit lake.

3.3.3.1.2 Ground Water Quality

- Degradation of natural ground water quality by chemicals such that concentrations exceed applicable water quality standards, or render water unsuitable for other existing or potential beneficial uses. For ground water that does not meet applicable water quality standards for baseline conditions, degradation would be considered significant where a change in water quality would render the water unsuitable for an existing or potential beneficial use. This criterion is based on NAC 445A.424.

- Degradation of natural soil chemistry by cyanide, trace metals, or other compounds such that concentrations exceed NDEP guidance levels. NDEP guidance levels for soils are based on results of MWMP testing that are ten times the DWS for each compound. This guidance is designed to protect ground water from contamination by leachate from overlying soils.

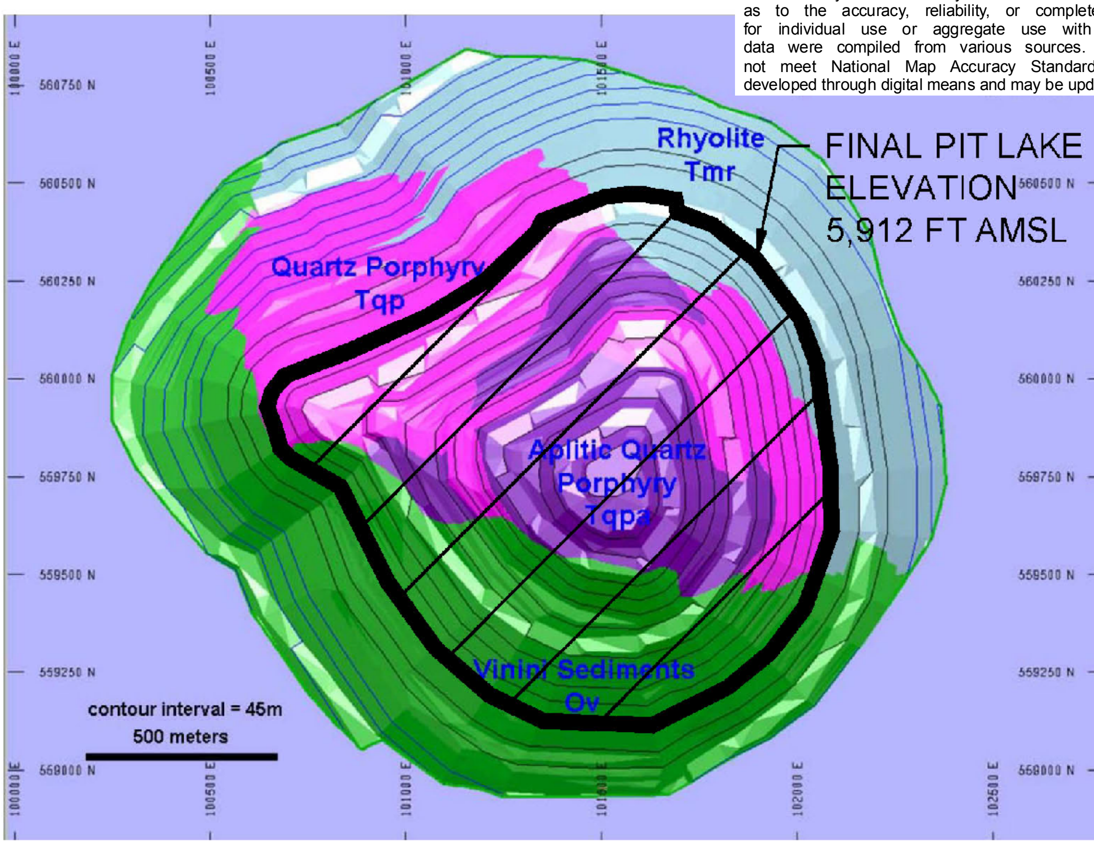
3.3.3.2 Assessment Methodology

3.3.3.2.1 Pit Lake Water Quality

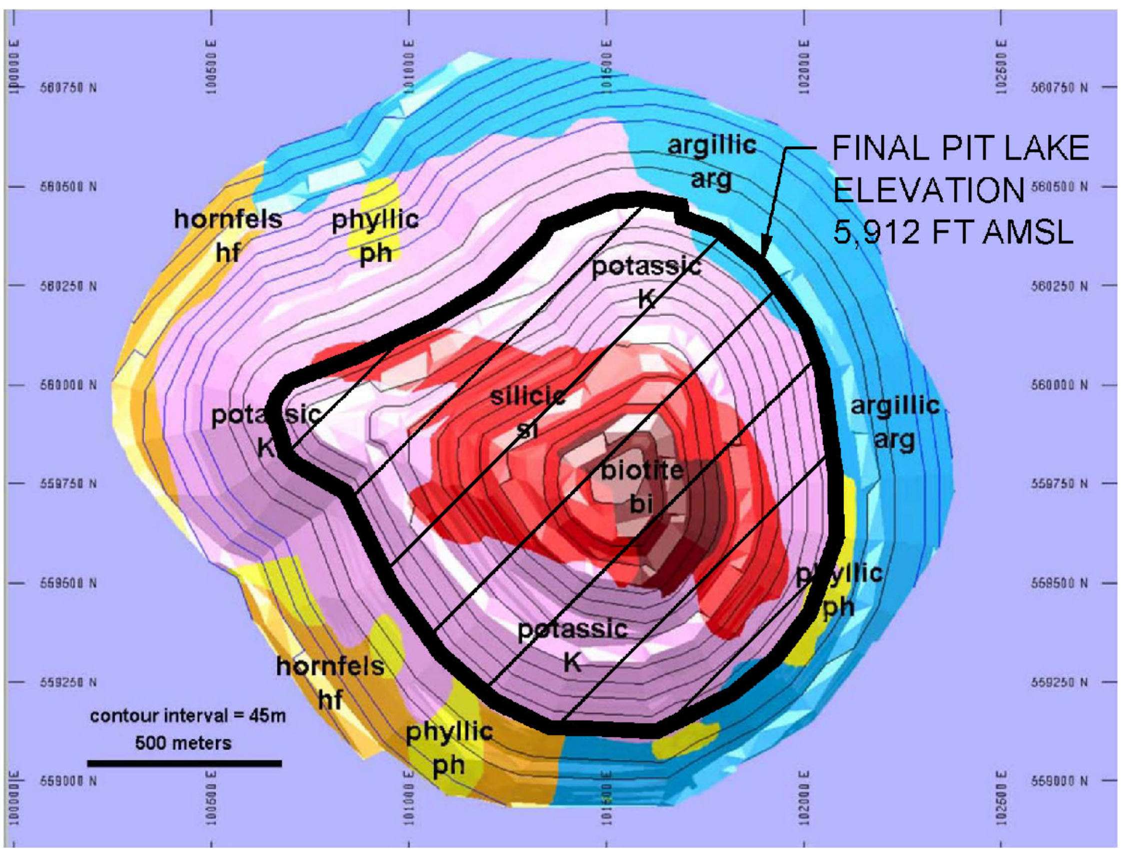
Pit lake water quality was assessed in a study by SWS (2010). The model is based on pit infilling data, the ABA and HC data, the chemistry of the local and regional ground water, and the characteristics of the final open pit shell.

The pit lake water quality assessment (SWS 2010) used as its base the distribution of lithologic units, alteration types, and ABA characteristics in the open pit shell developed by SRK (2008d) (Figures 3.3.9 and 3.3.10). This model was developed using Mintec's Mine Site software, based on the data set of over 1,500 pulp samples with ABA results. There were little sampling data from some of the pit wall areas because of the relatively cylindrical nature of the orebody. Where there was a lack of data, a nearest neighbor approach was used to conservatively assign the ABA characteristics of the pit wall. The choice of extrapolating to the pit wall from the core of the ore deposit is believed to be conservative, as the geologic work on the orebody indicates that mineralization becomes more diffuse at the fringes of the deposit, making a lower potential for acid generating material in these areas.

The HCT data, ground water quality data, and ground water inflow data have been discussed in depth in other sections of this document. The data flow of the pit lake study is represented in Figure 3.3.11. The base model uses average humidity cell effluent concentrations to calculate the release of materials from the pit wall due to surface runoff and ground water infilling to the open pit. Assumptions underlying this loading include consideration of the damage to the wall rock due to mining, blasting and surface sloughing of materials. For the base case pit lake model, a scaling factor to account for differences in laboratory and field reaction rates was not incorporated into the model (although it was incorporated into sensitivity analyses). Typically, laboratory reaction rates occur one to three orders of magnitude faster than field reaction rates



Final Pit Alteration Assemblages



PIT LAKE

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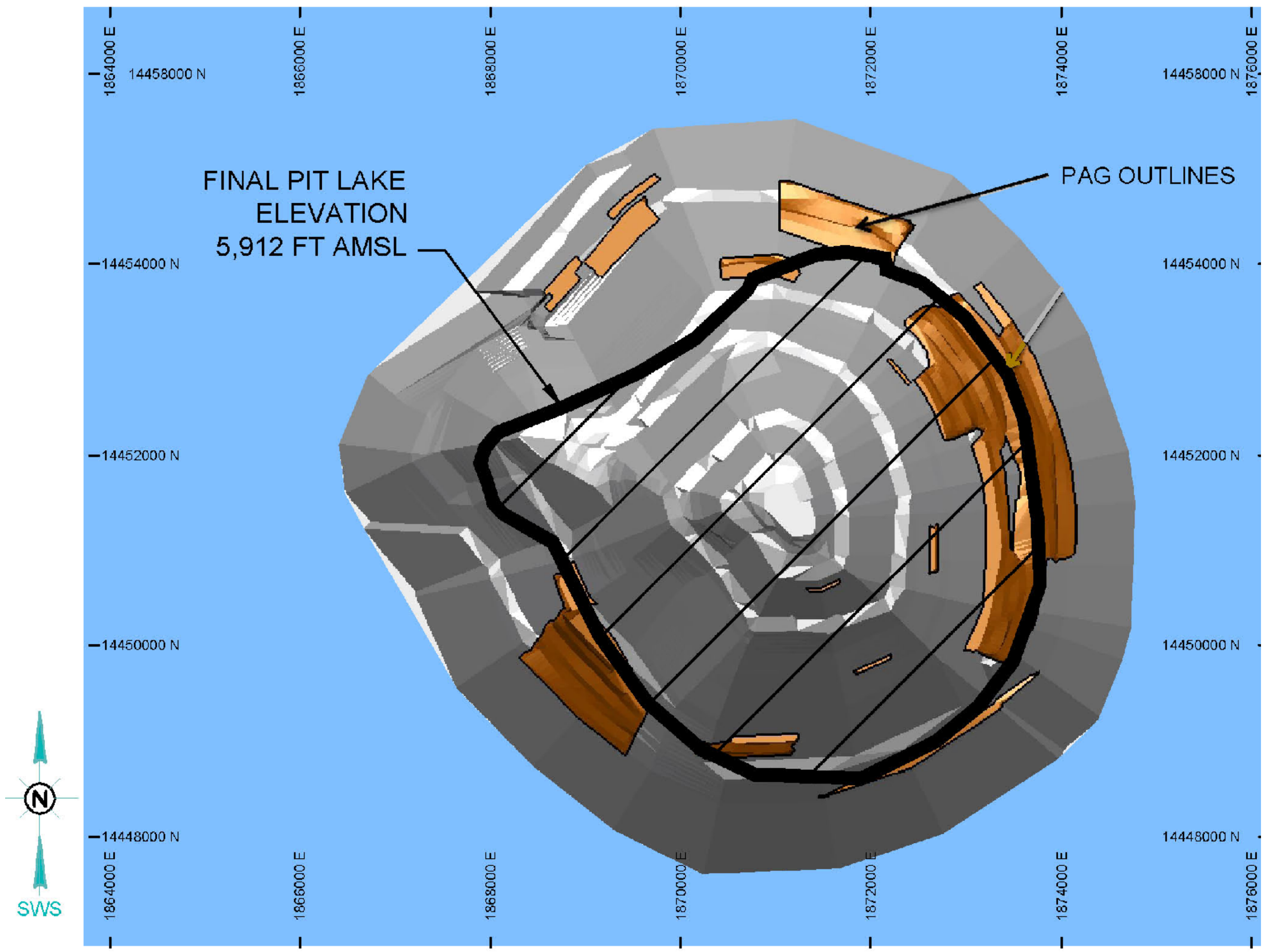
Final Pit Wall Lithologies and Alteration Assemblages in the Mount Hope Pit

Figure 3.3.9



PIT LAKE

PAG MATERIAL (PROJECTED) ON PIT WALLS

PAG: POTENTIALLY-ACID GENERATING (SRK, 2009a)

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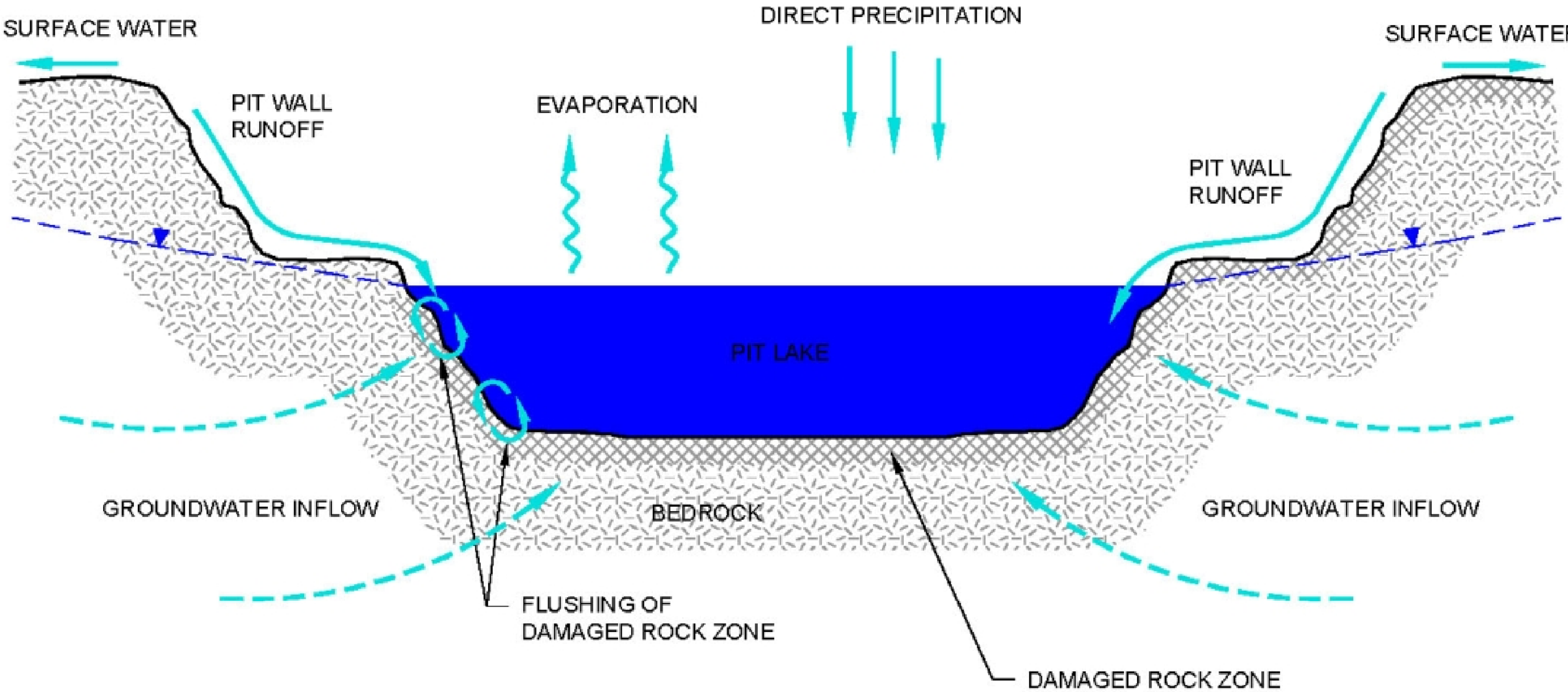

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Conceptual Model of the Mount Hope Pit Lake

Figure 3.3.11

(Sverdrup and Warfvinge 1995; Drever and Clow 1995; Li et al. 2008). Incorporating this factor would result in less loading to the lake and an overall improvement in the predicted water quality. Additional information on the pit lake water quality assessment is presented in detail in SWS (2010).

3.3.3.2.2 Waste Rock Draindown Water Quality

The water quality of drainage from waste rock is estimated from the results of HCTs. In the mine plan (SWS 2010), average HCT effluents are scaled based on estimates of waste volumes from different formations in the mine plan (SWS 2010). Similar to the pit lake water quality issue, these concentrations are not adjusted for differences in laboratory and field reaction rates.

3.3.3.2.3 Tailings Draindown Water Quality

Results of HCTs of tailings material indicate that draindown water from tailings would have a circumneutral pH (between 7 and 7.4) and may contain several regulated ground water constituents at elevated levels, including As, Al, Sb, fluoride, and Mo (SRK 2008d). Metals concentrations in actual field settings are expected to be lower than the laboratory values due to the slower rates of field processes (Sverdrup and Warfvinge 1995) and the inhibited oxidation of tailings in the inundated conditions of the tailings ponds.

3.3.3.3 Proposed Action

3.3.3.3.1 Surface Water Quality Impacts

The Project would require the alteration or diversion of existing natural drainages and washes that contain surface flow during the infrequent periods of high rainfall and snowmelt. The planned storm water diversion structures would be designed to divert flows of a 100-year, 24-hour storm event from the unnamed drainages upstream of the facilities. The tailings facilities are designed to contain a 100-year, 24-hour storm event in addition to normal process fluids. Surface disturbance generally increases the potential for erosion; therefore, sediment from increased erosion may be transported to and accumulate in the local surface drainages. During mine operations, standard erosion prevention and maintenance procedures (see Section 2.1.1**4.11**) would reduce impacts to less than significant levels based on the significance criteria outlined in Section 3.3.3.1.

Small drainages affected by roads and small facility structures would be returned to their natural condition during reclamation. Permanent drainage alterations around the open pit, WRDFs, and the South TSF would consist of open channels and berms. Such features would be left in place and reclaimed using vegetation or rock lining for stability and elimination of long-term maintenance under post-closure conditions. In addition, the tops of the two TSFs would be designed with a concave surface creating an evaporation basin or playa to retain and evaporate the average monthly precipitation and the 100-year, 24-hour storm event. This design is intended to ensure the long-term integrity of the TSF closure. The North TSF has been designed without an upstream diversion structure. As a result, there would be a potential for substantial storm water run-on that could exceed the design capacity of the North TSF evaporation basin and cause over topping of the structure and erosion of the reclaimed surfaces.

- **Impact 3.3.3.3-1:** There would be a moderate to high potential for impacts to surface water quality due to erosion and possible breaching of the North TSF under the Proposed Action.

  Significance of the Impact: The impact is considered potentially significant.

- **Mitigation Measure 3.3.3.3-1:** EML would submit a North TSF upstream diversion structure design. This design would be of sufficient capacity to divert run-on from the North TSF so that the current evaporate pond design would be sufficient to contain the designed storm events. The design would be submitted to the BLM 24 months prior to the anticipated start of construction. The BLM would approve the design prior to the commencement of construction.

- **Effectiveness of Mitigation and Residual Effects:** Implementation of the Mitigation Measure 3.3.3.3-1 would be effective at preventing erosion and possible breaching of the North TSF. The design would be based on an engineering evaluation of the topography and design precipitation event (24 hour-100 year event) as required by the NDEP so that the design event would effectively be conveyed away from the North TSF.

There is a potential impact to the flow of Roberts Creek resulting from mine-related ground water drawdown under the Proposed Action. A decrease in the flow of Roberts Creek could result in an inability to meet the beneficial uses outlined for a Class A surface water body.

- **Impact 3.3.3.3-2:** The ground water drawdown is predicted to be greater than ten feet for the perennial stream segments of Roberts Creek for varying periods of time up to at least 400 years after the end of mining and milling operations.

  Significance of the Impact: The impact is considered potentially significant.

- **Mitigation Measure 3.3.3.3-2:** The measures outlined under Mitigation Measure 3.2.3.3-2 would address the potential reduced flows outlined in the impact.

- **Effectiveness of Mitigation and Residual Effects:** Implementation of the Mitigation Measure 3.3.3.3-2 would be effective at preventing degradation of water quality in Roberts Creek. The mitigation measure would restore flows to the creek, which would remove the underlying cause of this potential impact.

3.3.3.3.2 Ground Water Quality Impacts

The Proposed Action includes the lining of the PAG WRDF (see Section 2.1.3.1) with the following: 1) a 12-inch thick engineered subgrade (1×10^{-5} cm/sec saturated hydraulic conductivity) and a five-foot thick **non-PAG** base layer for the foundation of the facility; 2) perforated collecting piping with geomembrane under the pipe to promote drainage from the base of the facility to a collection channel at the toe of the facility; 3) diversion channels to route upgradient surface water runoff away from the facility; 4) geomembrane-lined collection channel to route runoff and infiltration into a PAG/low-grade ore storm water collection ponds (Phase 1 and Phase 2); and 5) geomembrane-lined storm water collection ponds (Phase 1 and Phase 2) to capture surface water runoff and infiltration from the facilities. In general, HCT and MWMP testing of non-acid generating materials has found the effluent from these materials to be generally benign. For non-acid generating materials, elevated pH, Mn, and SO_4 are sometimes observed. However, the average chemistry from the non-acid generating materials only exceeds water quality criteria for Al (0.87 mg/L) and Mn (1.47 mg/L). Under the circumneutral pH conditions of the draindown, Al would be expected to precipitate (Lindsay 1979). Mn **values are** already found at levels **above regulatory standards (0.0076 to 25 mg/L) in ground water beneath the site and the levels in the potential seepage would be similar to the existing water quality values beneath the site**. Therefore, the Mn in the draindown would not degrade ground water beneath the non-acid generating waste rock piles. No ground water impacts are anticipated from the disposal of potentially acid generating material as this material would be underlain by a constructed compacted liner preventing leachate loading to ground water.

Each TSF would consist of the following components: impoundment; tailings conveyance and distribution system; reclaim recovery systems; and tailings draindown recovery systems (Figure 2.1.15). Figure 2.1.5 shows the locations of the North and South TSFs. The tailings production rate would range from approximately 21 to 23 million tpy for the 44 years of operation. The combined storage capacity of the TSFs is approximately 966 million dry tons.

The South TSF would have a capacity of approximately 790 million tons, which would equate to approximately 36 years of production. The South TSF would be constructed once the North TSF facility reaches capacity at Year 36, to contain 176 million tons, which would equate to approximately eight years of production.

The TSF embankment foundation and impoundment basin would be lined using a 60 mil (0.06 inch) LLDPE geomembrane, with a K value of 1 x 10^{-11}cm/s to provide fluid containment. This level of containment exceeds that required by the State of Nevada under NAC 445A.437 for facilities with ground water in excess of 100 feet.

As previously discussed, the water quality of the tailings and PAG waste rock draindown would exceed water quality standards for many constituents. To address this potential water quality impact, both the tailings facility and the PAG waste rock facility would be underlain by liners, and drainage from these facilities collected and managed. This planned management would prevent these low-quality waters from degrading either surface or ground water quality.

Upon closure, both the tailings and the PAG WRDF would be capped and revegetated to reduce the amount of infiltration to these facilities. Water draining from these facilities would continue to be managed through the use of evaporation cells.

Based on the ore and waste rock characteristics, the arid conditions of the mine site limit the amount of infiltration and using the Proposed Action management of mine wastes, the impacts to water quality from stockpiled ore and waste rock are considered less than significant based on the significance criteria outlined in Section 3.3.3.1.

- **Impact 3.3.3.3-3:** There would be a low potential for impacts to ground water quality due to drainage from tailings impoundments and waste rock piles under the Proposed Action.

  Significance of the Impact: The impact is not considered significant.

No mitigation is proposed for this impact; see Section 3.1.1 for a general discussion of significance and the development of mitigation measures.

3.3.3.3.3 Pit Lake Water Quality Impacts

The pit lake that is anticipated to form in the open pit is expected to fill slowly (Figure 3.3.12), and would be 900 feet deep at 200 years after the end of mining. Overall, the lake is predicted to have a slightly alkaline pH (approximately 7.7) and a moderate alkalinity (approximately 60 mg/L $CaCO_3$) (Figure 3.3.13). As most metals associated with ARD are less mobile at these pH values, overall the water is predicted to be of good quality (Table 3.3-3). Of constituents that are regulated by the State of Nevada, fluoride, SO_4 (Figure 3.3.14), Cd, Mn (Figure 3.3.15), Sb, and Zn (Figure 3.3.16) are expected to be near or above Nevada reference standards and EPA drinking water MCLs Table 3.3-3 water quality criteria (Table 3.3-1).

Initial pit lake water quality is predicted to be good and would meet Nevada enforceable DWS. As evaporation from the lake surface concentrates the dissolved minerals, some water quality constituent concentrations would be predicted to increase over time relative to baseline concentrations and to exceed the present Nevada water quality standards (see Table 3.3-1). The pit lake would be a water of the State of Nevada, and applicable water quality standards would depend on the present and potential beneficial uses of the lake. Access to the open pit by humans and livestock would be restricted. The lake is not intended to be a drinking water source for humans or livestock or to be used for recreational purposes. Therefore, standards to protect these beneficial uses would not be directly applicable. Aquatic standards would also not be applicable since EML does not plan to have the pit lake stocked with fish. This approach is consistent with NAC 445A.429. Exposure to terrestrial and avian wildlife species is discussed in Section 3.23.3.

- **Impact 3.3.3.3-4:** There would be a low potential for impacts to ground water quality due to the formation of a ground water sink in the open pit under the Proposed Action.

  Significance of the Impact: The impact is not considered significant.

  No mitigation is proposed for this impact; see Section 3.1.1 for a general discussion of significance and the development of mitigation measures.

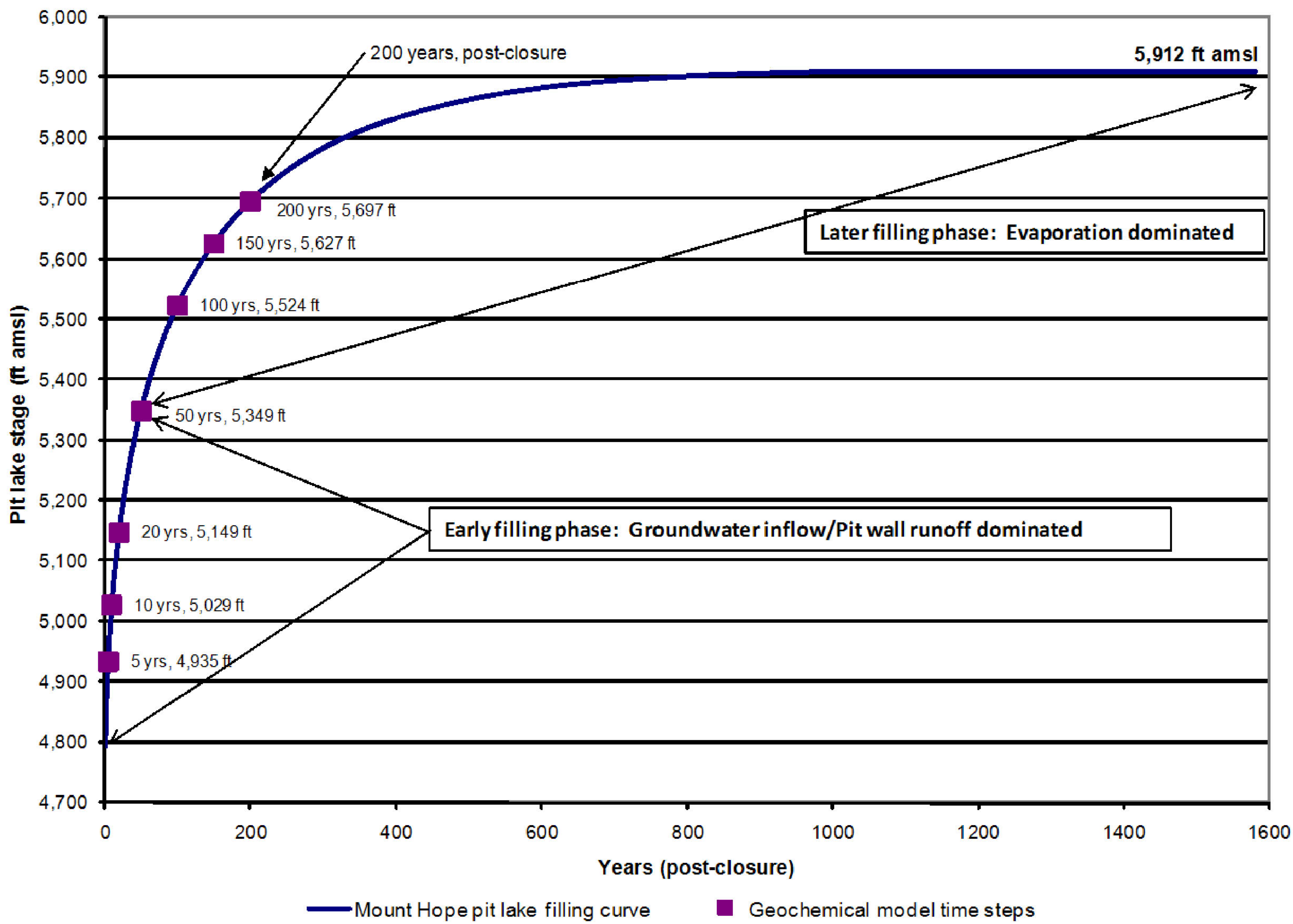
3.3.3.4 No Action Alternative

Implementation of the No Action Alternative is not expected to impact either surface or ground water quality. As there would be no change in the flow regime and no additional pumping, ground water quality is not expected to change. Surface water quality with regard to suspended solids is anticipated to improve as roads and drill sites are reclaimed.

3.3.3.5 Partial Backfill Alternative

3.3.3.5.1 Surface Water Quality Impacts

The Project would require the alteration or diversion of existing natural drainages and washes that contain surface flow during the infrequent periods of high rainfall and snowmelt. The planned storm water diversion structure has been designed to divert flows of a 100-year, 24-hour storm event from the unnamed drainages upstream of the facilities. The tailings facilities would



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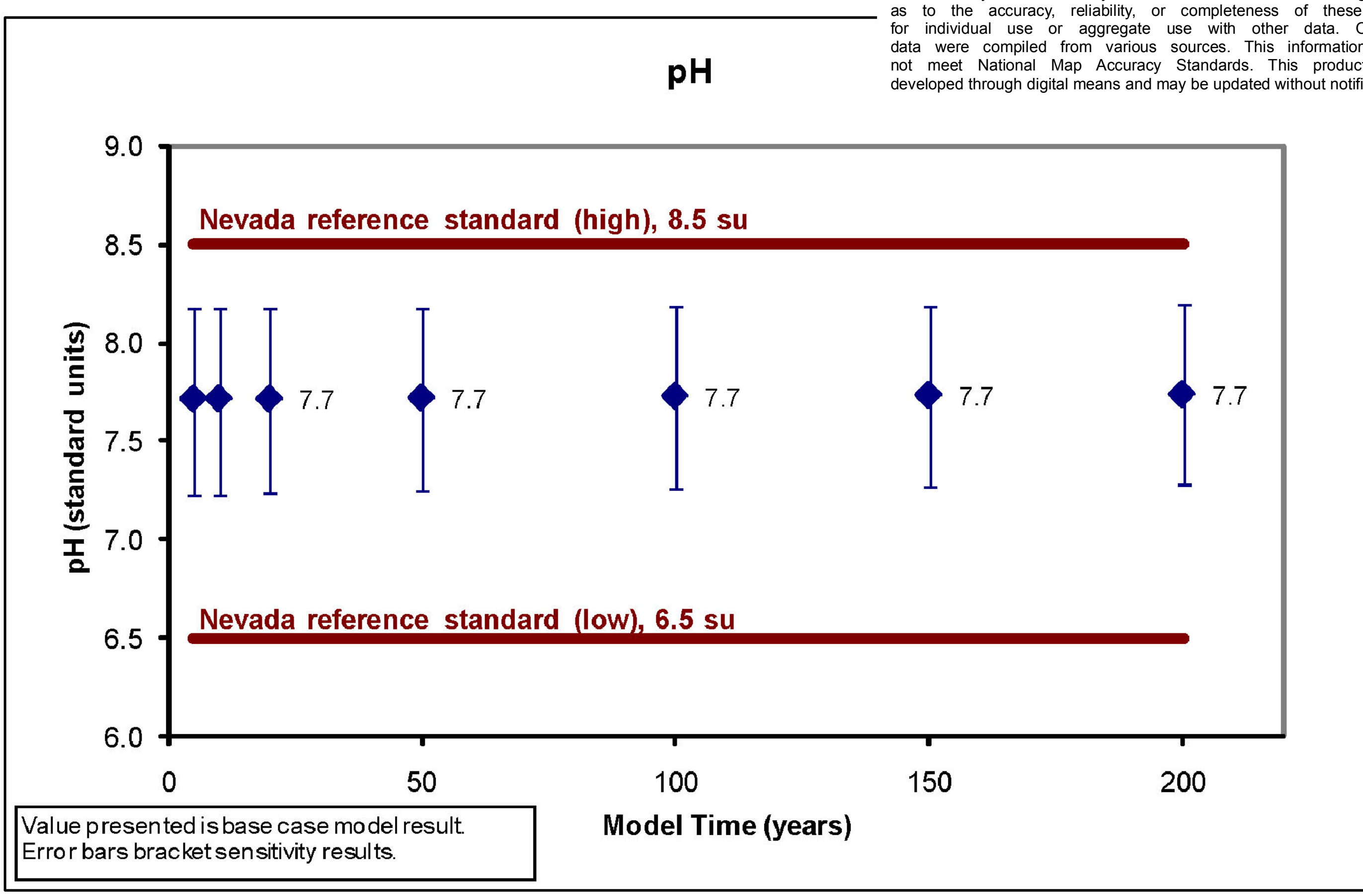
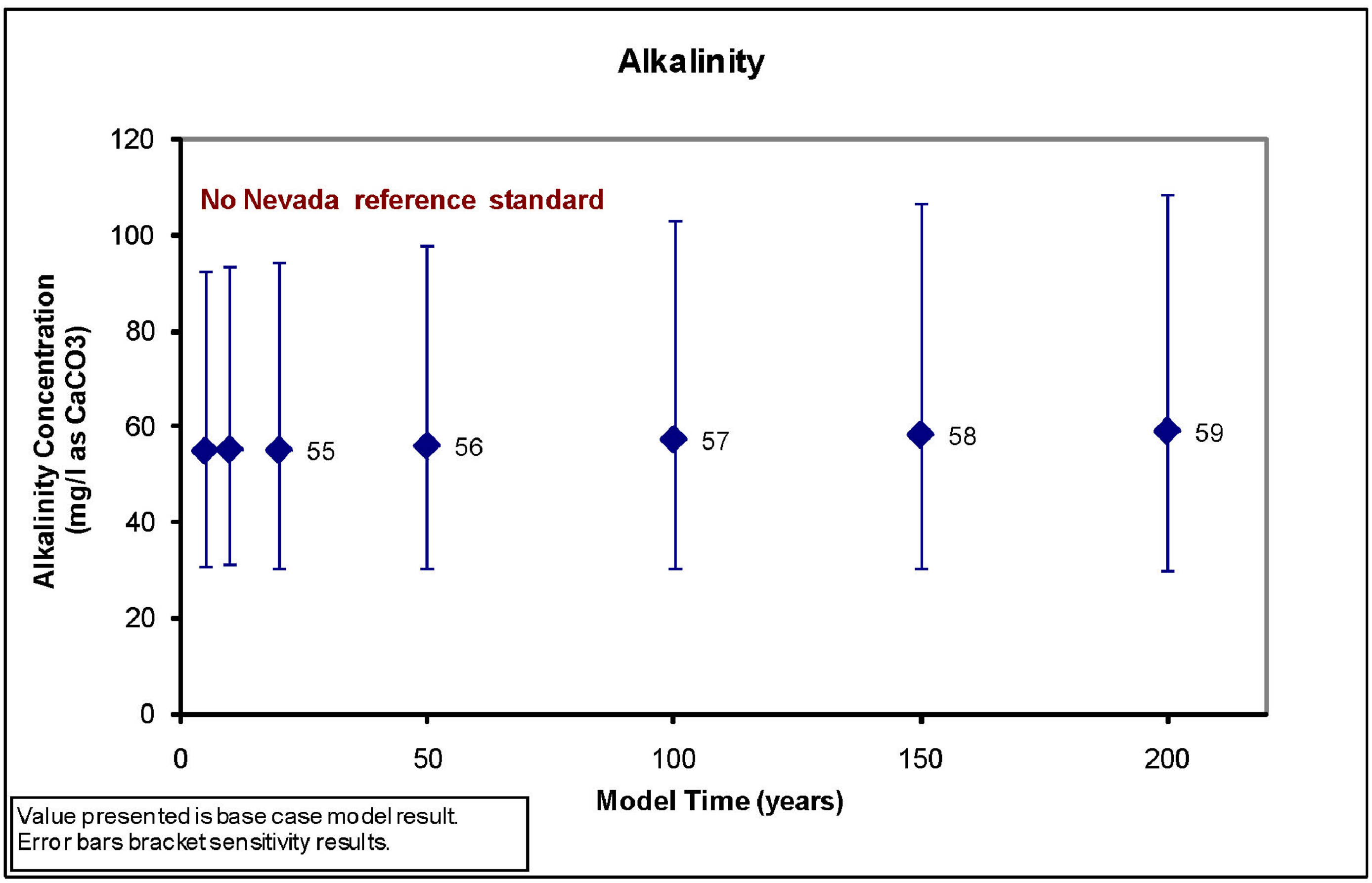
Projected Pit Lake Filling Curve of the Mount Hope Pit Lake

Figure 3.3.12





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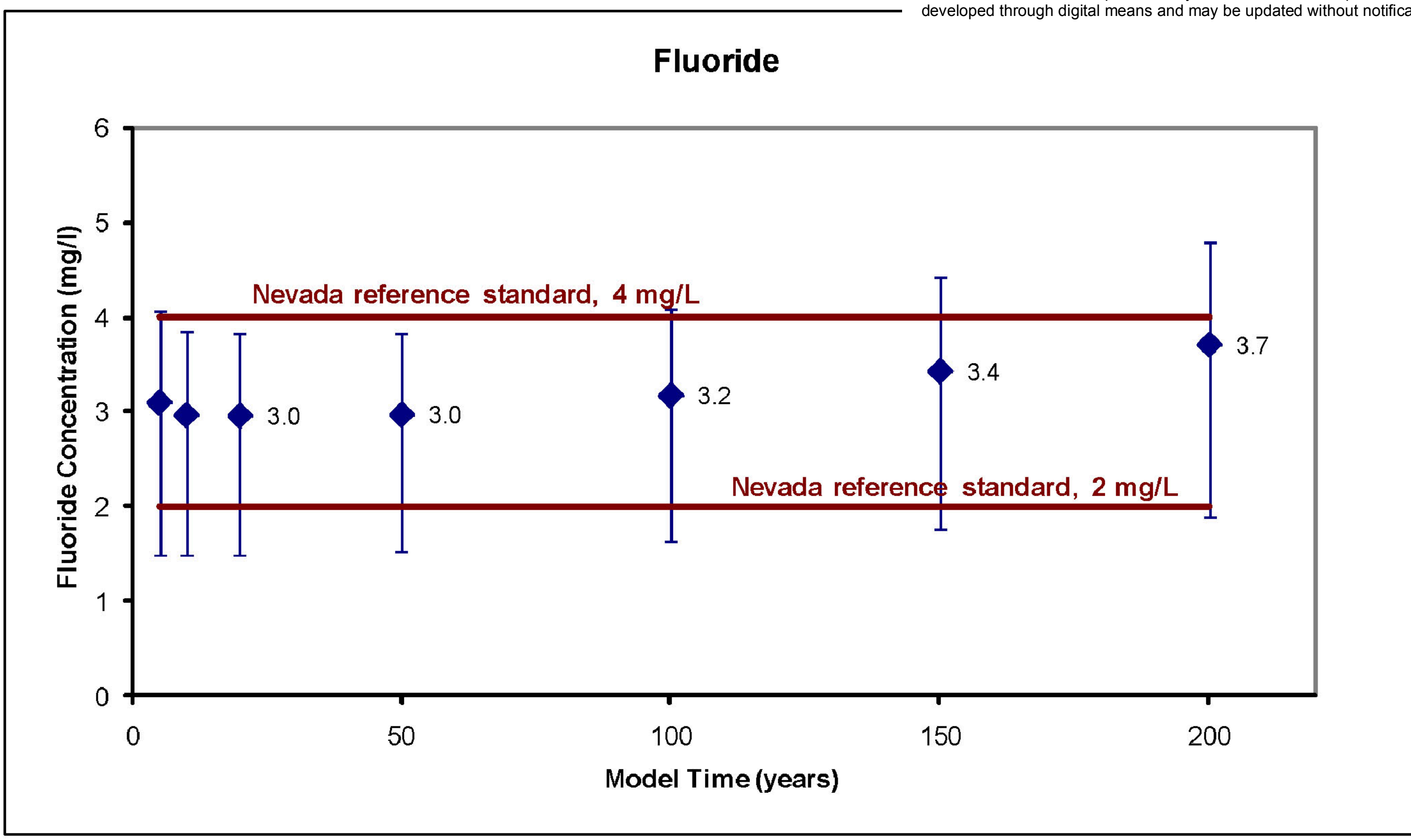
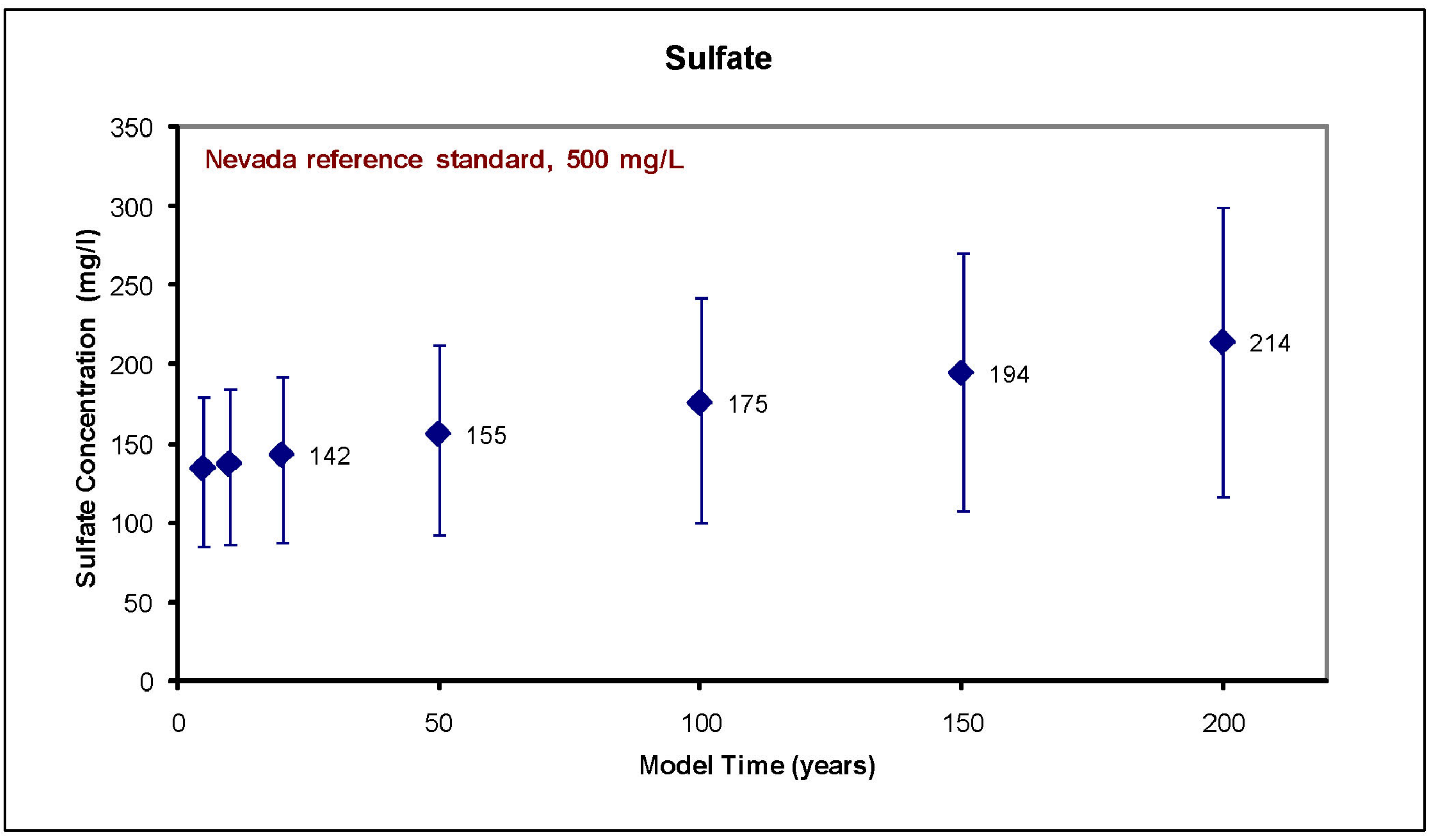
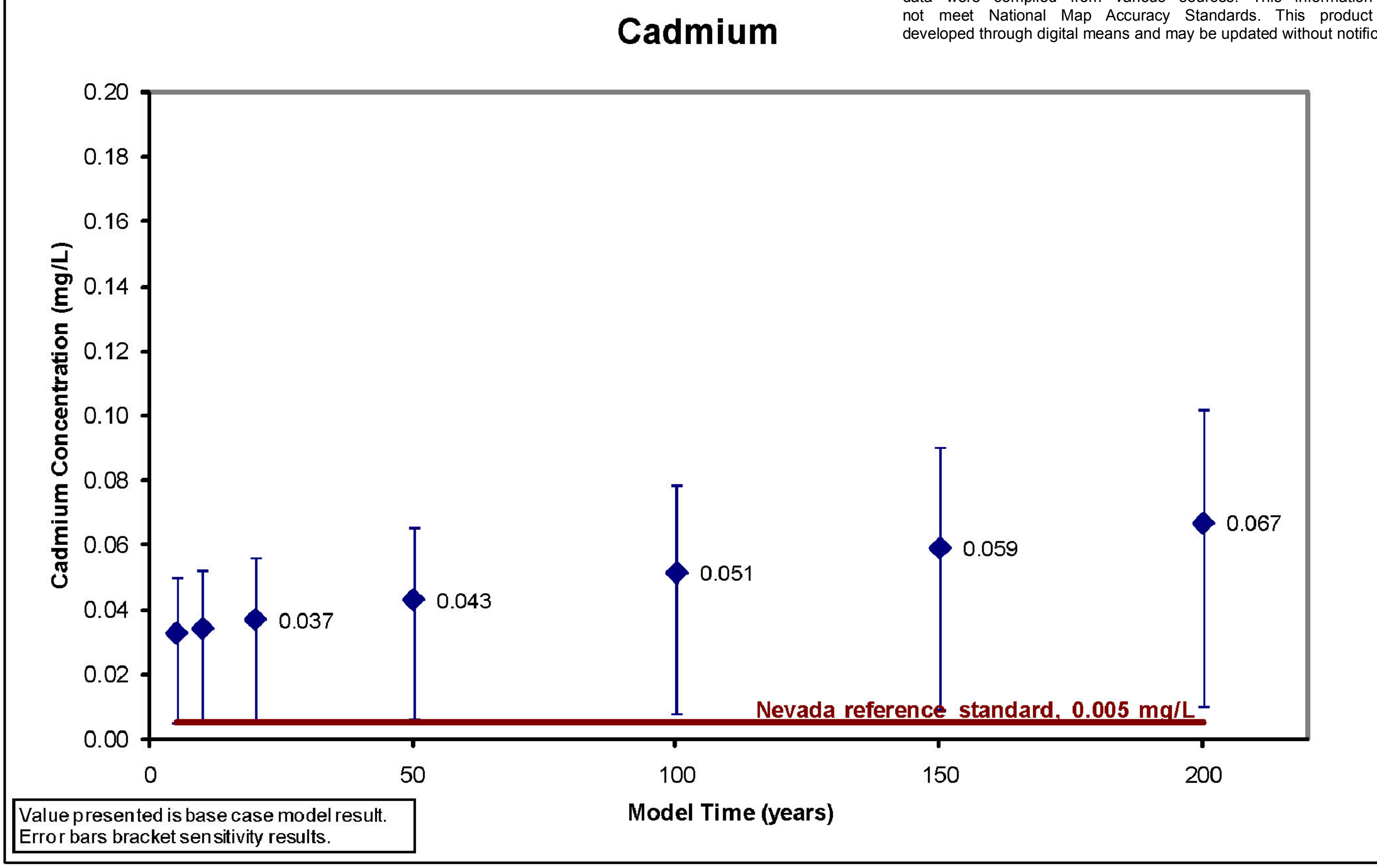
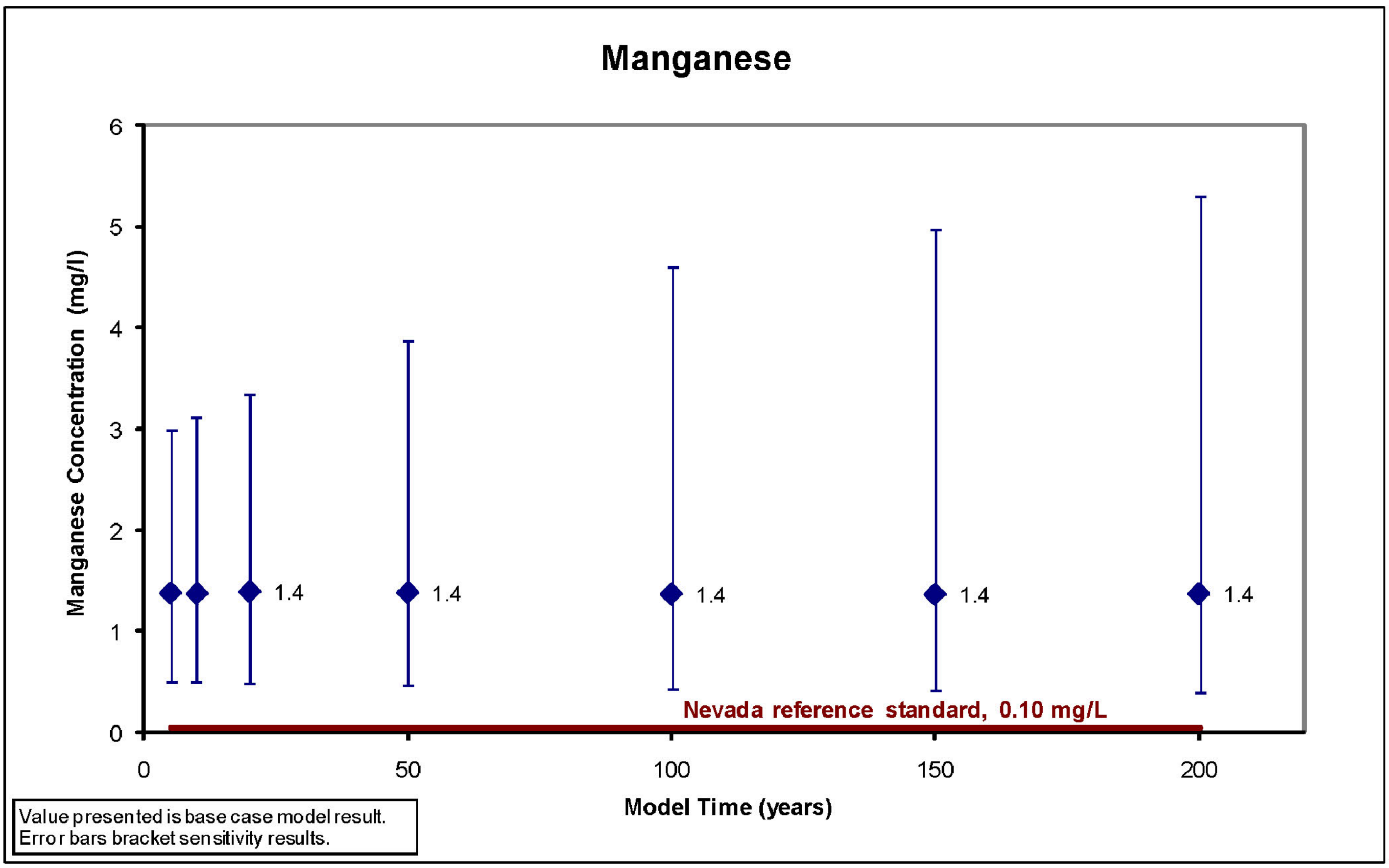




BATTLE MOUNTAIN DISTRICT OFFICE Mount Lewis Field Office 50 Bastian Road Battle Mountain, Nevada 89820			BUREAU OF LAND MANAGEMENT MOUNT HOPE PROJECT	DRAWING TITLE: **Projected Fluoride and Sulfate in the Mount Hope Pit Lake (SWS 2010)** **Figure 3.3.14**
DESIGN: EMLLC	DRAWN: GSL	REVIEWED: RFD		
CHECKED: -	APPROVED: RFD	DATE: 09/22/2011		
FILE NAME: p1635_Fig3-3-X_Geochem_8i11i_portrait.mxd				





BATTLE MOUNTAIN DISTRICT OFFICE Mount Lewis Field Office 50 Bastian Road Battle Mountain, Nevada 89820	BUREAU OF LAND MANAGEMENT MOUNT HOPE PROJECT	DRAWING TITLE: Projected Cadmium and Manganese in the Mount Hope Pit Lake (SWS 2010) Figure 3.3.15
DESIGN: EMLLC; DRAWN: GSL; REVIEWED: RFD		
CHECKED: -; APPROVED: RFD; DATE: 09/22/2011		
FILE NAME: p1635_Fig3-3-X_Geochem_8i11i_portrait.mxd		

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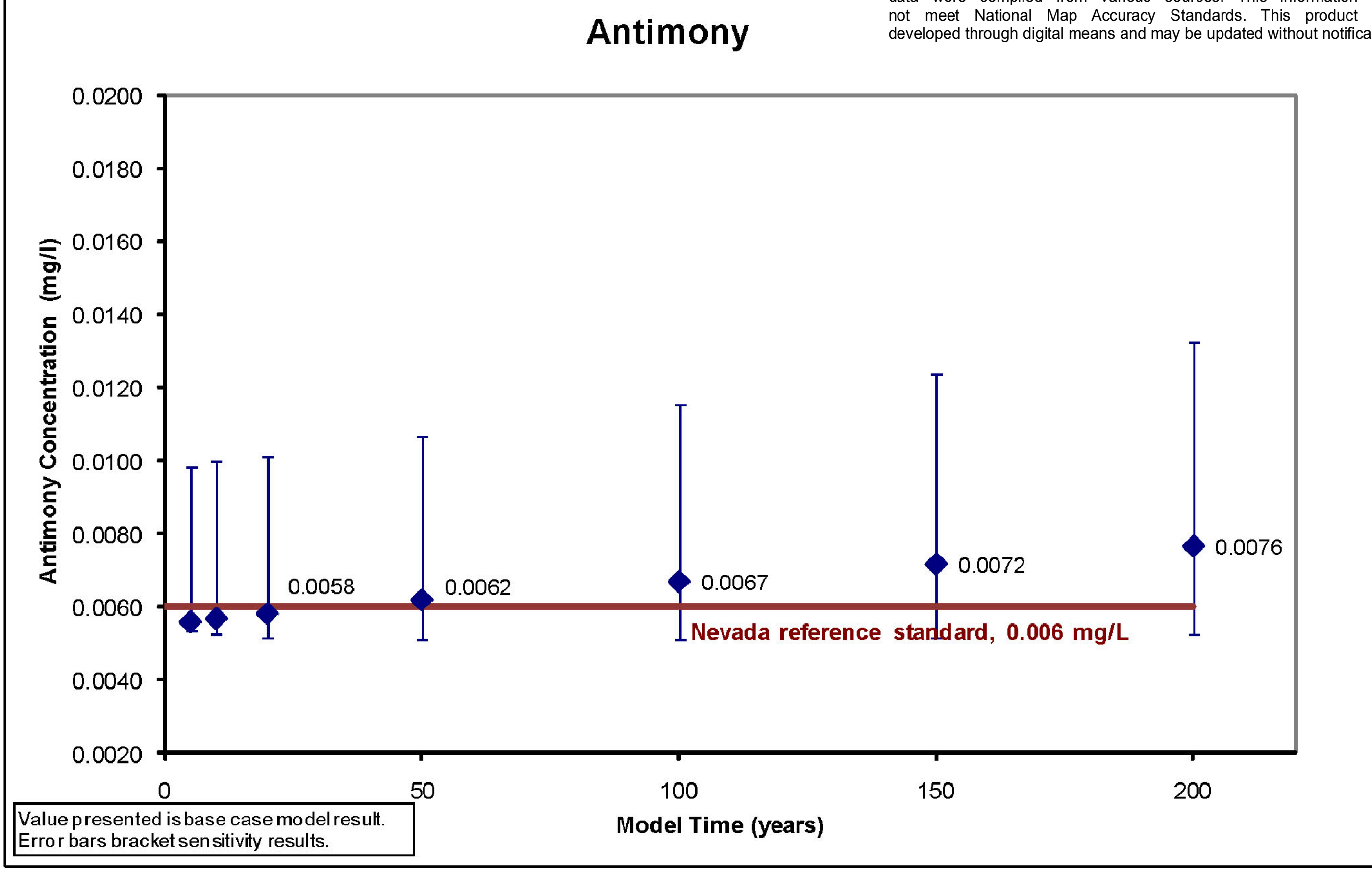

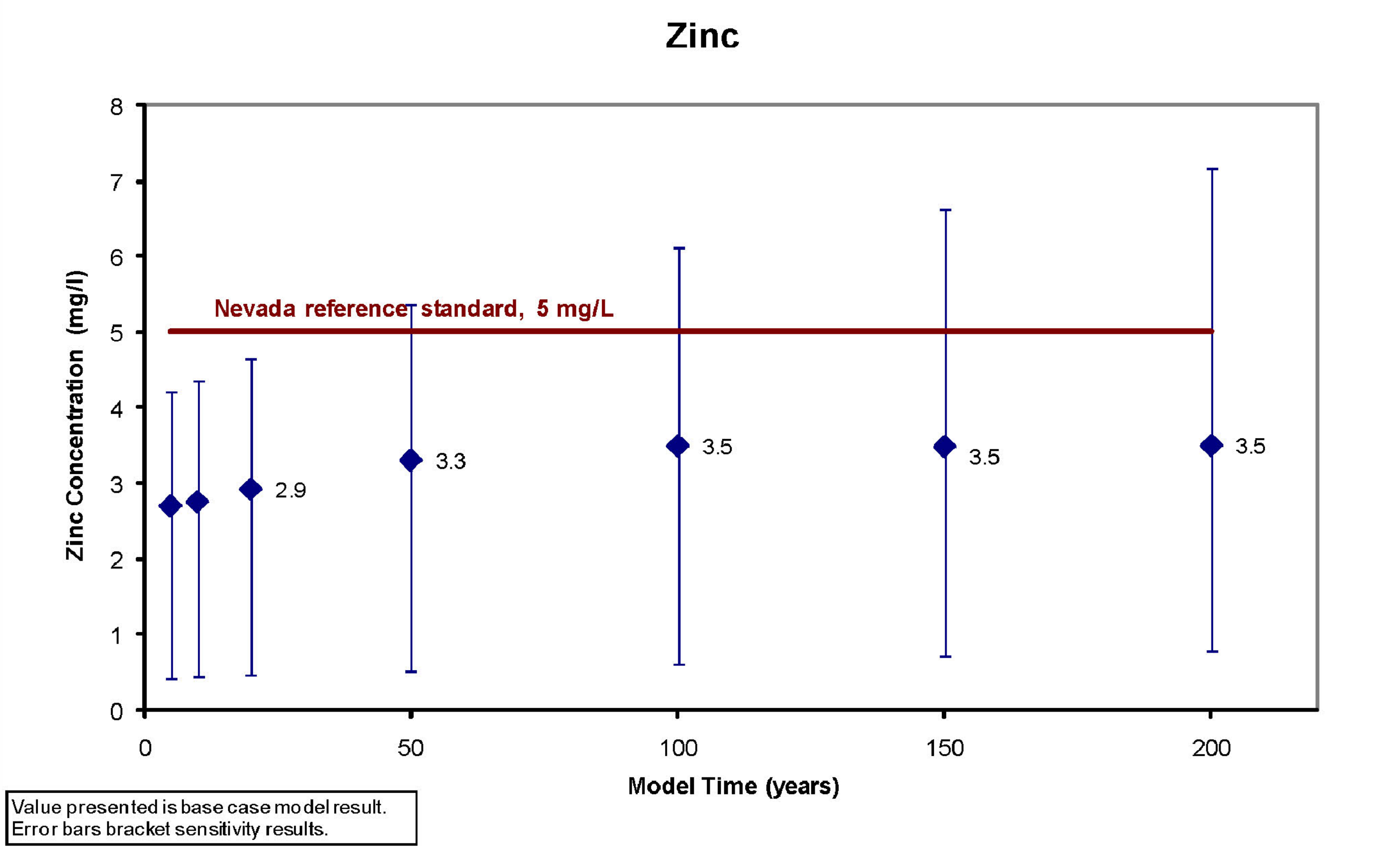

	BATTLE MOUNTAIN DISTRICT OFFICE Mount Lewis Field Office 50 Bastian Road Battle Mountain, Nevada 89820	BUREAU OF LAND MANAGEMENT MOUNT HOPE PROJECT	DRAWING TITLE: Projected Antimony and Zinc in the Mount Hope Pit Lake Figure 3.3.16
	DESIGN: EMLLC; DRAWN: GSL; REVIEWED: RFD		
	CHECKED: -; APPROVED: RFD; DATE: 09/22/2011		
	FILE NAME: p1635_Fig3-3-X_Geochem_8i11i_portrait.mxd		

Table 3.3-3: Mount Hope Predicted Pit Lake Water Quality Results

Parameter/Analyte	Nevada Reference Standards	USEPA Drinking Water MCLs	Pit Lake (Time)						
			5 years	10 years	20 years	50 years	100 years	150 years	200 years
pH, standard units	**6.5 - 8.5***	**6.5 - 8.5***	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Major Ions									
Alkalinity, as $CaCO_3$	**ns**	**ns**	55	55	55	56	57	58	59
Chloride	**400***	**250***	8.2	8.3	8.4	8.8	9.5	10.1	10.8
Fluoride	**4.0 (2.0*)**	**4.0 (2.0*)**	3.1	3.0	3.0	3.0	3.2	3.4	3.7
Nitrate, As N	**10**	**10**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorus	**ns**	**ns**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulfate, as SO_4^{2-}	**500***	**250***	134	136	142	155	175	194	214
Calcium	**ns**	**ns**	46	46	47	50	54	58	62
Magnesium	**150***	**ns**	7.3	7.4	7.6	8.1	8.9	9.6	10.4
Potassium	**ns**	**ns**	4.5	4.6	4.7	5.1	5.7	6.3	6.8
Sodium	**ns**	**ns**	26	27	28	30	34	38	42
Metals/Metaloids									
Aluminum	**0.2***	**0.05 - 0.2***	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Antimony	**0.006**	**0.006**	0.0056	0.0057	0.0058	0.0062	0.0067	0.0072	0.0076
Arsenic	**0.01**	**0.01**	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Barium	**2**	**2**	0.014	0.014	0.013	0.012	0.011	0.011	0.010
Beryllium	**0.004**	**0.004**	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Bismuth	**ns**	**ns**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	**ns**	**ns**	<0.05	<0.05	<0.05	<0.05	0.053	0.059	0.065
Cadmium	**0.005**	**0.005**	0.033	0.034	0.037	0.043	0.051	0.059	0.067
Chromium	**0.1**	**0.1**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	**ns**	**ns**	0.009	0.009	0.010	0.011	0.013	0.014	0.016
Copper	**1.0* (1.3**)**	**1.0* (1.3**)**	0.015	0.0149	0.016	0.016	0.018	0.018	0.018

Parameter/Analyte	Nevada Reference Standards	USEPA Drinking Water MCLs	Pit Lake (Time)						
			5 years	10 years	20 years	50 years	100 years	150 years	200 years
Iron	**0.6***	**0.3***	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	**0.015****	**0.015****	0.00045	0.00043	0.00045	0.00048	0.00051	0.00052	0.00053
Lithium	**ns**	**ns**	0.0042	0.0045	0.0048	0.0057	0.0069	0.0079	0.0090
Manganese	**0.10***	**0.05***	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Mercury	**0.002**	**0.002**	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	**ns**	**ns**	0.074	0.078	0.083	0.094	0.11	0.12	0.13
Nickel	**0.1**	**ns**	0.023	0.023	0.025	0.028	0.034	0.038	0.043
Selenium	**0.05**	**0.05**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver	**0.1***	**0.1***	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Strontium	**ns**	**ns**	0.22	0.22	0.22	0.23	0.24	0.26	0.28
Thallium	**0.002**	**0.002**	0.00055	0.00056	0.00058	0.00063	0.00069	0.00075	0.00083
Tin	**ns**	**ns**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	**ns**	**ns**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	**5.0***	**5***	2.7	2.7	2.9	3.3	3.5	3.5	3.5

STANDARDS PRESENTED ARE NOT APPLICABLE TO THE PIT LAKE WATER. FOR REFERENCE PURPOSES ONLY.

Nevada Reference Standards are based on Nevada primary and secondary **DWS**, action levels, and beneficial use standards.
* Based on secondary standards. ** Based on Pb and Cu action levels. ns - no standards.
Exceedances of a Nevada Reference Standards are highlighted.
All concentrations are in mg/L, unless otherwise noted.
< Analyte concentration result is below typical analytical detection limits. The value shown is the detection limit.

be designed to contain a 100-year, 24-hour storm event in addition to normal process fluids. Surface disturbance generally causes an increase in erosion, therefore, sediment from increased erosion may be transported to and accumulate in the local surface drainages. During mine operations, standard erosion prevention and maintenance procedures (see Section 2.1.15) would reduce impacts to less than significant levels.

Small drainages affected by roads and small facility structures would be returned to their natural condition during reclamation. Permanent drainage alterations around the open pit, WRDFs, and the South TSF would consist of open channels and berms. Such features would be left in place and reclaimed using revegetation or rock lining for stability and elimination of long-term maintenance under post-closure conditions. In addition, the tops of the two TSFs would be designed with a concave surface creating an evaporation basin or playa to retain and evaporate the average monthly precipitation and the 100-year, 24-hour storm event. This design is intended to ensure the long-term integrity of the TSF closure. The North TSF has been designed without an upstream diversion structure. As a result, there would be a potential for substantial storm water run-on that could exceed the design capacity of the North TSF evaporation basin and cause over topping of the structure and erosion of the reclaimed surfaces.

■ **Impact 3.3.3.5-1:** There would be a moderate to high potential for impacts to surface water quality due to erosion and possible breaching of the North TSF under the Partial Backfill Alternative.

  Significance of the Impact: The impact is considered potentially significant.

■ **Mitigation Measure 3.3.3.5-1:** EML would submit a North TSF upstream diversion structure design. This design would be of sufficient capacity to divert run-on from the North TSF so that the current evaporate pond design would sufficient to contain the designed storm events. The design would be submitted to the BLM 24 months prior to the anticipated start of construction. The BLM would approve the design prior to the commencement of construction.

■ **Effectiveness of Mitigation and Residual Effects:** Implementation of the Mitigation Measure 3.3.3.5-1 would be effective preventing erosion and possible breaching of the North TSF. The design would be based on an engineering evaluation of the topography and design precipitation event (24 hour-100 year event) as required by the NDEP so that the design event would effectively be conveyed away from the North TSF.

■ **Impact 3.3.3.5-2:** The ground water drawdown is predicted to be more than ten feet for the perennial stream segments of Roberts Creek for varying periods of time up to at least 400 years after the end of mining and milling operations.

  Significance of the Impact: The impact is considered potentially significant.

■ **Mitigation Measure 3.3.3.5-2:** The measures outlined under Mitigation Measure 3.2.3.5-2 would address the potential reduced flows outlined in the impact.

■ **Effectiveness of Mitigation and Residual Effects:** Implementation of the Mitigation Measure 3.3.3.5-2 would be effective at preventing degradation of water quality in

Roberts Creek. The mitigation measure would restore flows to the creek, which would remove the underlying cause of this potential impact.

3.3.3.5.2 Ground Water Quality Impacts

Under the Partial Backfill Alternative, ground water quality impacts from tailings and waste rock draindown would be expected to be similar to those under the pit lake alternative.

- **Impact 3.3.3.5-3:** There would be a low potential for impacts to ground water quality due to drainage from tailings impoundments and waste rock piles under the Partial Backfill Alternative.

  Significance of the Impact: The impact is not considered significant.

  No mitigation is proposed for this impact; see Section 3.1.1 for a general discussion of significance and the development of mitigation measures.

3.3.3.5.3 Pit Lake Water Quality Impacts

Under the Partial Backfill Alternative, the ground water quality within the pit backfill would be anticipated to be impacted by waste materials (Non-PAG) deposited in the open pit and from infiltrating the runoff from pit walls. This poor-quality water could flow from the confines of the former pit shell into the surrounding ground water, degrading waters of the state. Assuming that non-acid generating materials are placed in the open pit, the ground water entrained within the backfill would contain elevated levels of constituents observed in HCT draindown (Mn, SO_4, pH), as well as constituents found in runoff from the pit walls (including Cd, fluoride, and Mn) (SWS 2010). While a specific water balance has not been developed for the ground water entrained in the backfill, it is expected that this water quality would exceed Nevada **DWS** for the above listed constituents.

Under the Partial Backfill Alternative, the modeling conducted by InTerraLogic (2011) was designed to predict the composition of future pore water quality in the backfilled open pit. The results for the post-closure period, just prior to the point of well-defined ground water throughflow (approximately 210 years) are presented in Table 3.3-4. At the point of throughflow, the pH of the open pit backfill pore water is predicted to be circum-neutral, at a pH of approximately 6.8. Sulfate concentrations are low or below analytical detection; however, concentrations of fluoride, Sb, Cd, and Mn are predicted to be present above the Nevada Reference values (Table 3.3-4).

Table 3.3-4: Partial Backfill Alternative Predicted Pore Water Quality Results

Parameter/Analyte	Nevada Reference Standards (mg/L)	Backfill Pore Water Quality at 210 Years (mg/L)
pH, standard units	6.5 – 8.5*	6.8
Major Ions		
Alkalinity, as CaCO3	ns	64
Chloride	400*	12
Fluoride	4.0 (2.0*)	3.8
Nitrate, as N	10	<0.05

Parameter/Analyte	Nevada Reference Standards	Backfill Pore Water Quality at 210 Years
	(mg/L)	(mg/L)
Phosphorus	ns	<0.05
Sulfate, as SO_4^{2-}	500*	177
Calcium	ns	53
Magnesium	150*	9.3
Potassium	ns	11
Sodium	ns	37
Metals/Metaloids		
Aluminum	0.2*	0.044
Antimony	0.006	0.0061
Arsenic	0.01	<0.0005
Barium	2	0.012
Beryllium	0.004	<0.0002
Bismuth	ns	<0.001
Boron	ns	0.11
Cadmium	0.005	0.037
Chromium	0.1	<0.001
Cobalt	ns	0.0083
Copper	1.0* (1.3**)	0.032
Iron	0.6*	0.57
Lead	0.015**	0.00028
Lithium	ns	0.0082
Manganese	0.10*	2.1
Mercury	0.002	<0.0002
Molybdenum	ns	0.36
Nickel	0.1	0.026
Selenium	0.05	0.0018
Silver	0.1*	<0.005
Strontium	ns	0.22
Thallium	0.002	0.0060
Tin	ns	0.0023
Titanium	ns	<0.001
Vanadium	ns	0.012
Zinc	5.0*	2.8

ns = no standard; * = based on secondary standard; ** = based Pb and Cu action levels.
Exceedances of the Nevada Reference Standards are highlighted.

Over the long term, water would continue to move through the backfill and into the downgradient ground water system (Diamond Valley). The chemistry of this throughflow water would gradually evolve as the readily-soluble chemical mass in the backfill is rinsed out. Eventually the throughflow water would resemble a mixture of the upgradient ground water, percolation of precipitation through the backfill, and open pit wall runoff**, which would exceed Nevada DWS.**

- **Impact 3.3.3.5-4:** It is expected that the ground water flowing from backfill material would exceed Nevada **DWS** under the Partial Backfill Alternative.

  Significance of the Impact: The impacts to ground water quality under the Partial Backfill Alternative would be significant.

- **Mitigation Measure 3.3.3.5-4:** Mitigation for this impact would require the removal of sufficient backfill material for the formation of an evaporative ground water sink.

Implementation of this mitigation would be otherwise inconsistent with the reasoning for selecting this alternative.

Residual Impact: Based on the assumption that the mitigation would not be implemented, the residual impact of the Partial Backfill Alternative on ground water quality would be the long-term degradation of the ground waters of the state.

3.3.3.6 Off-Site Transfer of Ore Concentrate for Processing Alternative

3.3.3.6.1 Surface Water Quality Impacts

Under the Off-Site Transfer of Ore Concentrate for Processing Alternative, surface water quality impacts would be similar to the Proposed Action.

- **Impact 3.3.3.6-1:** There would be a moderate to high potential for impacts to surface water quality due to erosion and possible breaching of the North TSF under the Off-Site Transfer of Ore Concentrate for Processing Alternative.

  Significance of the Impact: The impact is considered potentially significant.

- **Mitigation Measure 3.3.3.6-1:** EML would submit a North TSF upstream diversion structure design. This design would be of sufficient capacity to divert run-on from the North TSF so that the current evaporate pond design would be sufficient to contain the designed storm events. The design would be submitted to the BLM 24 months prior to the anticipated start of construction. The BLM would approve the design prior to the commencement of construction.

- **Effectiveness of Mitigation and Residual Effects:** Implementation of the Mitigation Measure 3.3.3.6-1 would be effective at preventing erosion and possible breaching of the North TSF. The design would be based on an engineering evaluation of the topography and design precipitation event (24 hour-100 year event) as required by the NDEP so that the design event would effectively be conveyed away from the North TSF. With the implementation of the mitigation measure, the residual impact of the Off-Site Transfer of Ore Concentrate for Processing Alternative would be limited to natural erosion processes.

- **Impact 3.3.3.6-2:** The ground water drawdown is predicted to be more than ten feet for the perennial stream segments of Roberts Creek for varying periods of time up to at least 400 years after the end of mining and milling operations.

  Significance of the Impact: The impact is considered potentially significant.

- **Mitigation Measure 3.3.3.6-2:** The measures outlined under Mitigation Measure 3.2.3.3-2 would address the potential reduced flows outlined in the impact.

- **Effectiveness of Mitigation and Residual Effects:** Implementation of the Mitigation Measure 3.3.3.6-2 would be effective at preventing degradation of water quality in Roberts Creek. The mitigation measure would restore flows to the creek, which would remove the underlying cause of this potential impact.

3.3.3.6.2 Ground Water Quality Impacts

Under the Off-Site Transfer of Ore Concentrate for Processing Alternative ground water quality impacts would be indistinguishable from the Proposed Action.

- **Impact 3.3.3.6-3:** There would be a low potential for impacts to ground water quality due to drainage from tailings impoundments and waste rock piles under the Off-Site Transfer of Ore Concentrate for Processing Alternative.

  Significance of the Impact: The impact is not considered significant.

  No mitigation is proposed for this impact; see Section 3.1.1 for a general discussion of significance and the development of mitigation measures.

3.3.3.6.3 Pit Lake Water Quality Impacts

Under the Off-Site Transfer of Ore Concentrate for Processing Alternative pit lake water quality impacts would be indistinguishable from the Proposed Action.

- **Impact 3.3.3.6-4:** There would be a low potential for impacts to ground water quality due to the formation of a ground water sink in the open pit under the Off-Site Transfer of Ore Concentrate for Processing Alternative.

  Significance of the Impact: The impact is not considered significant.

  No mitigation is proposed for this impact; see Section 3.1.1 for a general discussion of significance and the development of mitigation measures.

3.3.3.7 Slower, Longer Project Alternative

3.3.3.7.1 Surface Water Quality Impacts

Under the Slower, Longer Project Alternative, surface water quality impacts would be similar to the Proposed Action; however, the timing of those potential impacts could differ due to the extended operating time frames for this alternative.

- **Impact 3.3.3.7-1:** There would be a moderate to high potential for impacts to surface water quality due to erosion and possible breaching of the North TSF under the Slower, Longer Project Alternative.

  Significance of the Impact: The impact is considered potentially significant.

- **Mitigation Measure 3.3.3.7-1:** EML would submit a North TSF upstream diversion structure design. This design would be of sufficient capacity to divert run-on from the North TSF so that the current evaporate pond design would be sufficient to contain the designed storm events. The design would be submitted to the BLM 24 months prior to the anticipated start of construction. The BLM would approve the design prior to the commencement of construction.

- **Effectiveness of Mitigation and Residual Effects:** Implementation of the Mitigation Measure 3.3.3.7-1 would be effective at preventing erosion and possible breaching of the North TSF. The design would be based on an engineering evaluation of the topography and design precipitation event (24 hour-100 year event) as required by the NDEP so that the design event would effectively be conveyed away from the North TSF.
  With the implementation of the mitigation measure, the residual impact of the Slower, Longer Project Alternative would be limited to natural erosion processes.

- **Impact 3.3.3.7-2:** The ground water drawdown is predicted to be more than ten feet for the perennial stream segments of Roberts Creek for varying periods of time up to at least 400 years after the end of mining and milling operations.

  Significance of the Impact: The impact is considered potentially significant.

- **Mitigation Measure 3.3.3.7-2:** The measures outlined under Mitigation Measure 3.2.3.7-2 would address the potential reduced flows outlined in the impact.

- **Effectiveness of Mitigation and Residual Effects:** Implementation of the Mitigation Measure 3.3.3.7-2 would be effective at preventing degradation of water quality in Roberts Creek. The mitigation measure would restore flows to the creek, which would remove the underlying cause of this potential impact.

3.3.3.7.2 Ground Water Quality Impacts

Under the Slower, Longer Project Alternative ground water quality impacts would be indistinguishable from the Proposed Action; however, the timing of those potential impacts could differ due to the extended operating time frames for this alternative.

- **Impact 3.3.3.7-3:**There would be a low potential for impacts to ground water quality due to drainage from tailings impoundments and WRDFs under the Slower, Longer Project Alternative.

  Significance of the Impact: The impact is not considered significant.

  No mitigation is proposed for this impact; see Section 3.1.1 for a general discussion of significance and the development of mitigation measures.

3.3.3.7.3 Pit Lake Water Quality Impacts

Under the Slower, Longer Project Alternative pit lake water quality impacts would be indistinguishable from the Proposed Action.

- **Impact 3.3.3.7-4:** There would be a low potential for impacts to ground water quality due to the formation of a ground water sink in the open pit under the Slower, Longer Project Alternative.

  Significance of the Impact: The impact is not considered significant.

  No mitigation is proposed for this impact; see Section 3.1.1 for a general discussion of significance and the development of mitigation measures.

The Mount Hope **Final** EIS **is** continued in Volume II.